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**Ma**

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(54) **UMBRELLA HAVING A PIVOT JOINT TO PROVIDE ADDITIONAL DEGREES OF FREEDOM OF ORIENTATION OF ITS CANOPY**

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**A45B 17/00** (2006.01)  
**A45B 23/00** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **A45B 17/00** (2013.01); **A45B 23/00** (2013.01); **A45B 2017/005** (2013.01); **A45B 2023/0037** (2013.01); **A45B 2023/0056** (2013.01); **A45B 2023/0075** (2013.01)

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CPC A45B 25/02; A45B 17/00; A45B 2025/105; A45B 2023/0031; A45B 2023/0037; A45B 23/00; A45B 2017/005  
USPC ..... 135/90, 21, 20.3, 20.1  
See application file for complete search history.

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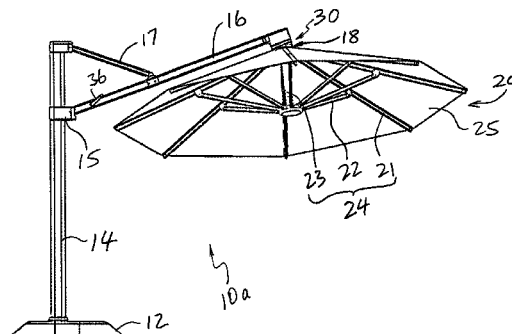
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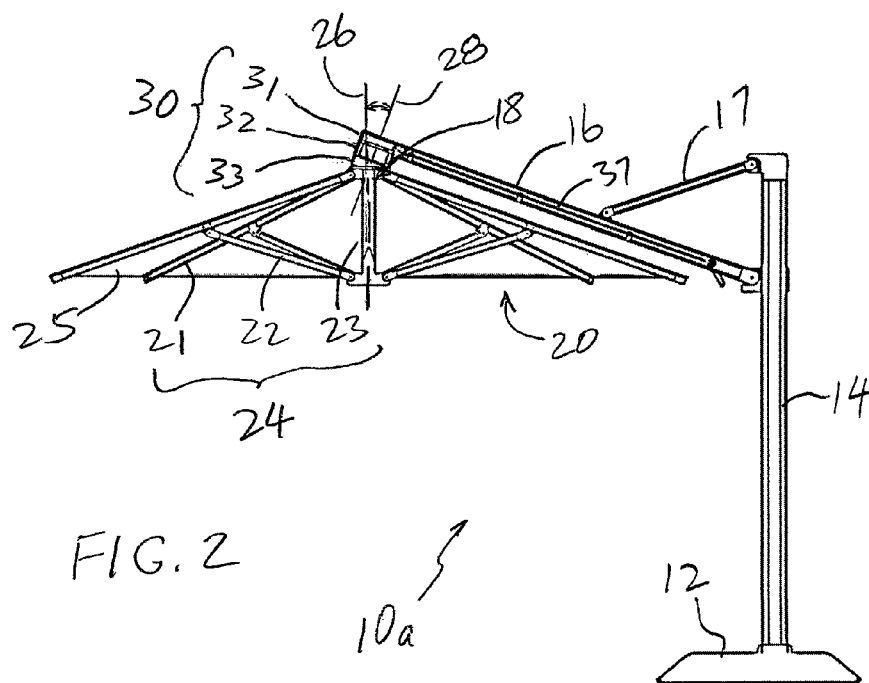
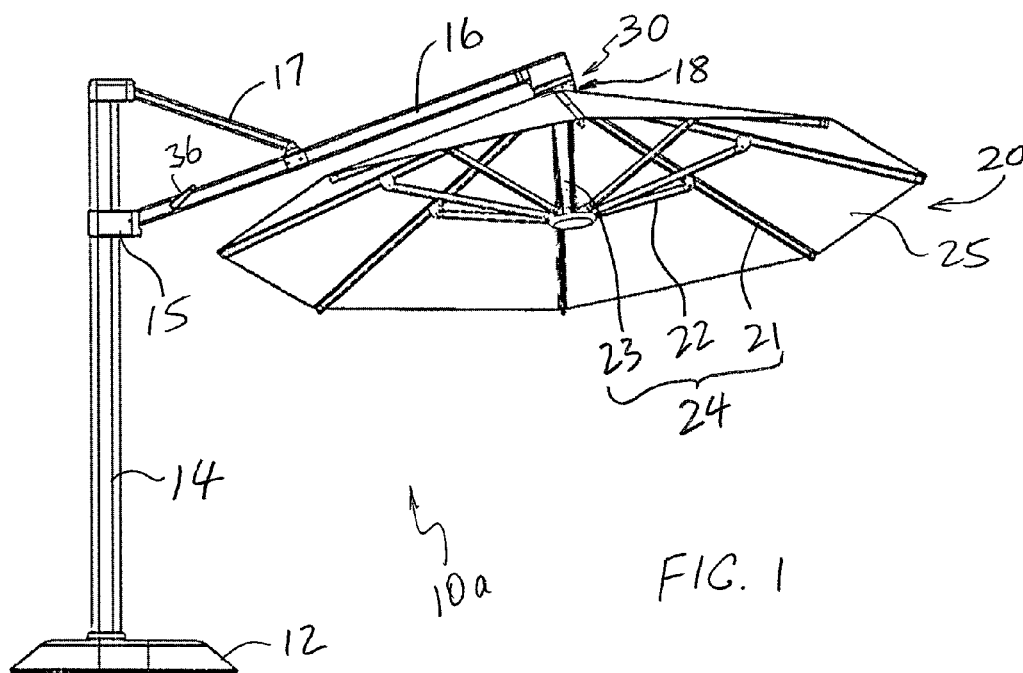
*Primary Examiner* — Winnie Yip  
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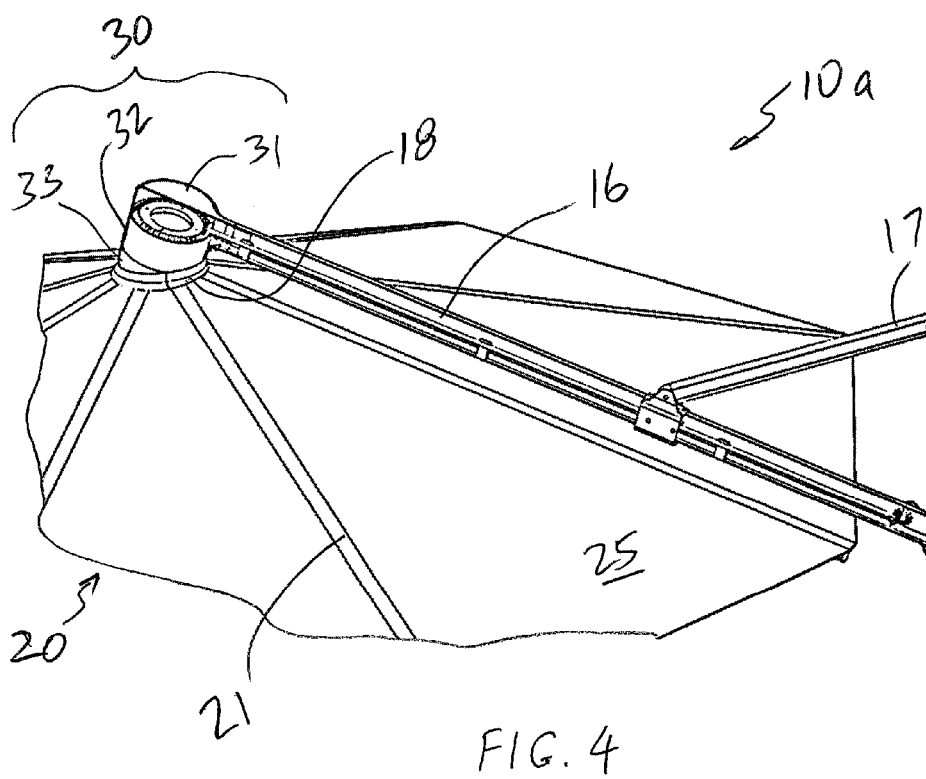
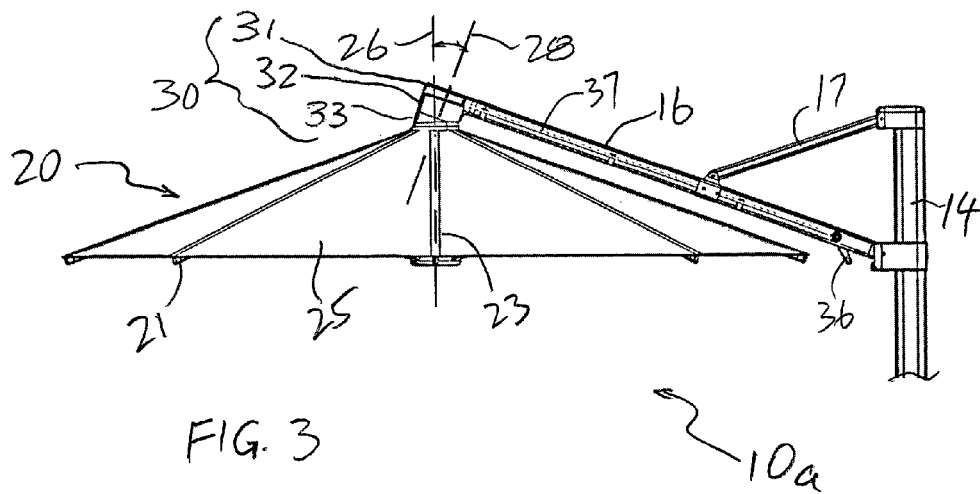
(57) **ABSTRACT**

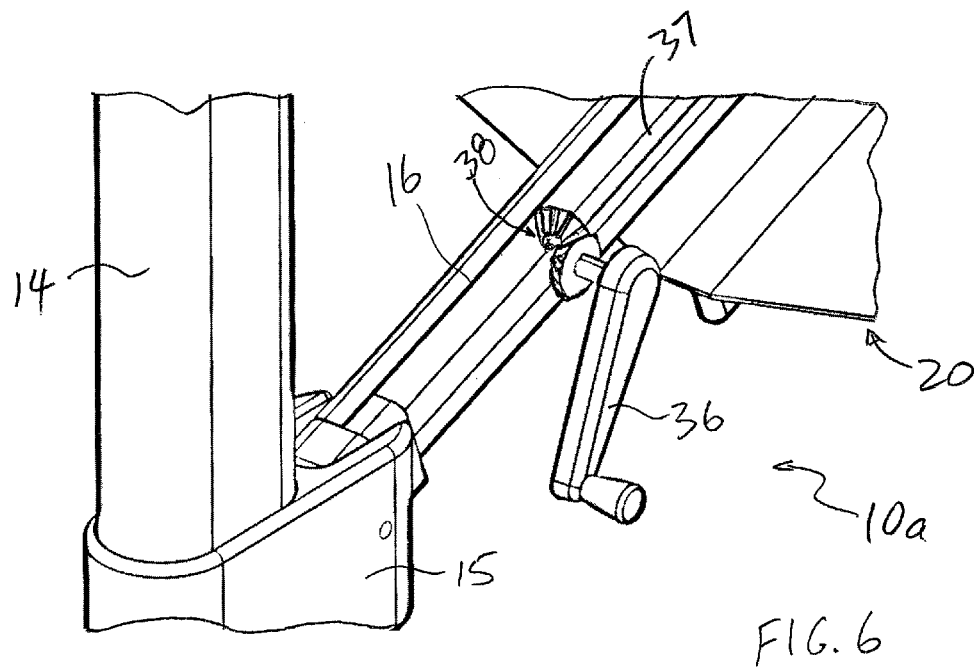
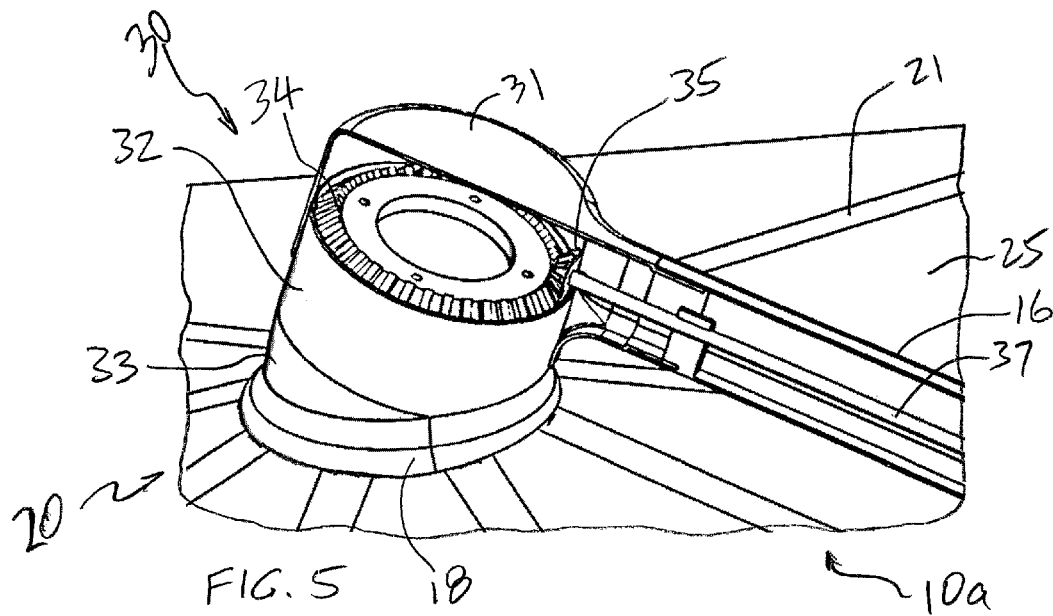
An umbrella having the crown of the canopy coupled to a support structure via a pivot joint that is structured and configured to allow swiveling and/or tilting of the canopy with ease by a user, in more than one plane or with more than one degree of freedom with respect to the support structure. The canopy frame includes a longitudinal central support hub, and the pivot joint is rotatable about a rotation axis, wherein the axis of the canopy support hub makes a fixed or variable non-zero angle with respect to the pivot joint rotation axis. As a result of the angle between the pivot joint rotation axis and the canopy support hub axis. The rotation of the pivot joint causes tilting of the canopy support hub axis, thus tilting the canopy to change its orientation.

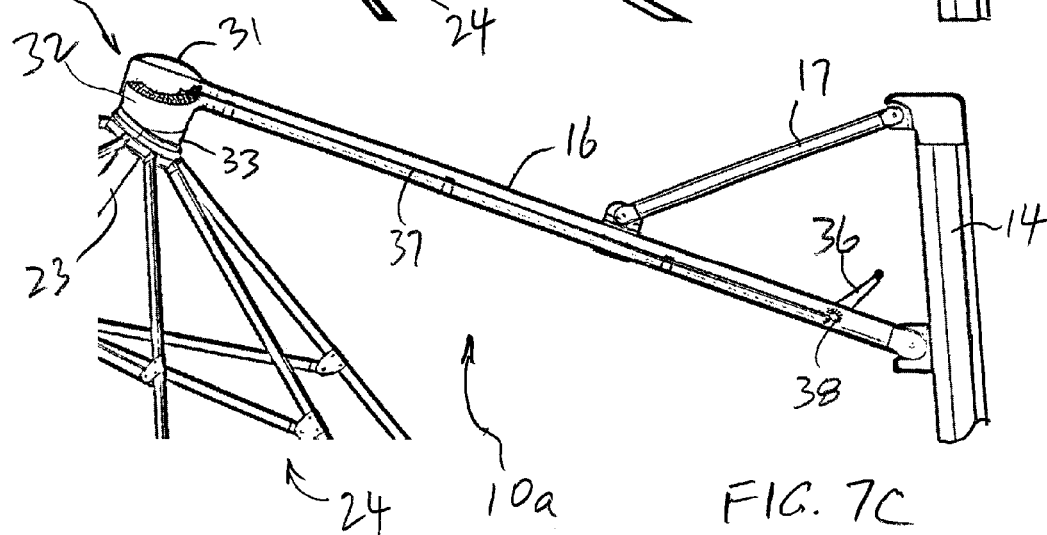
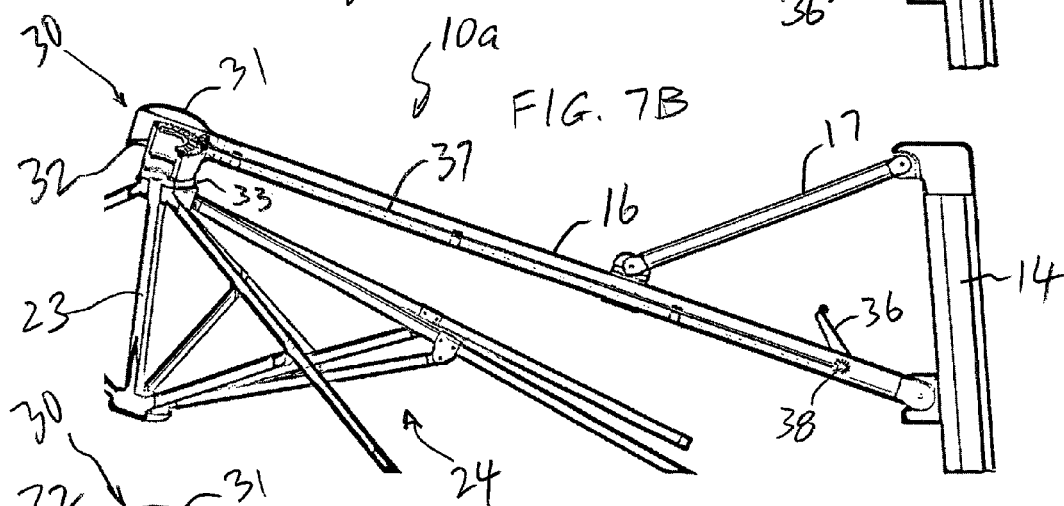
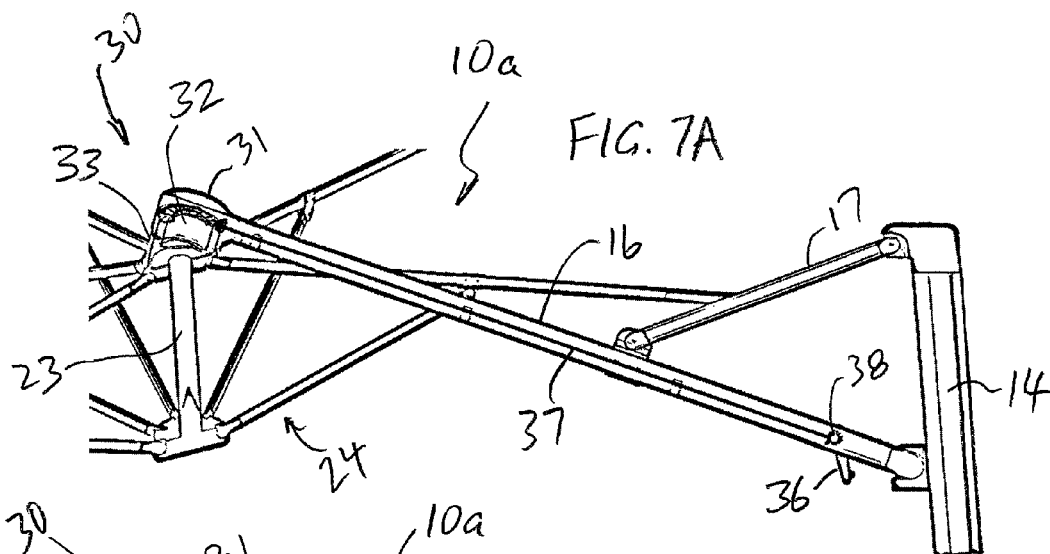
**19 Claims, 19 Drawing Sheets**

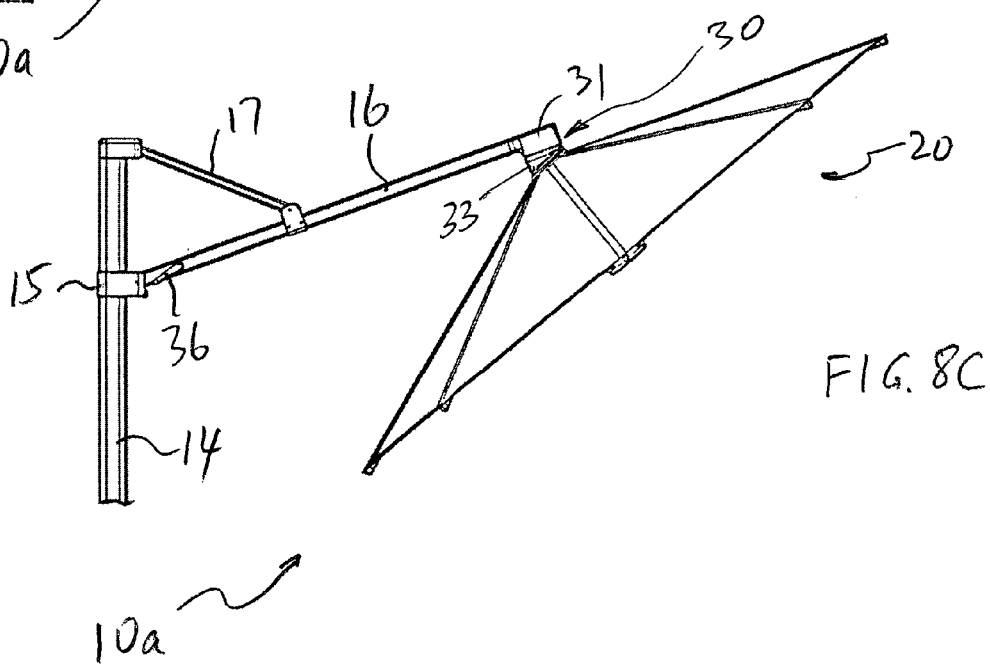
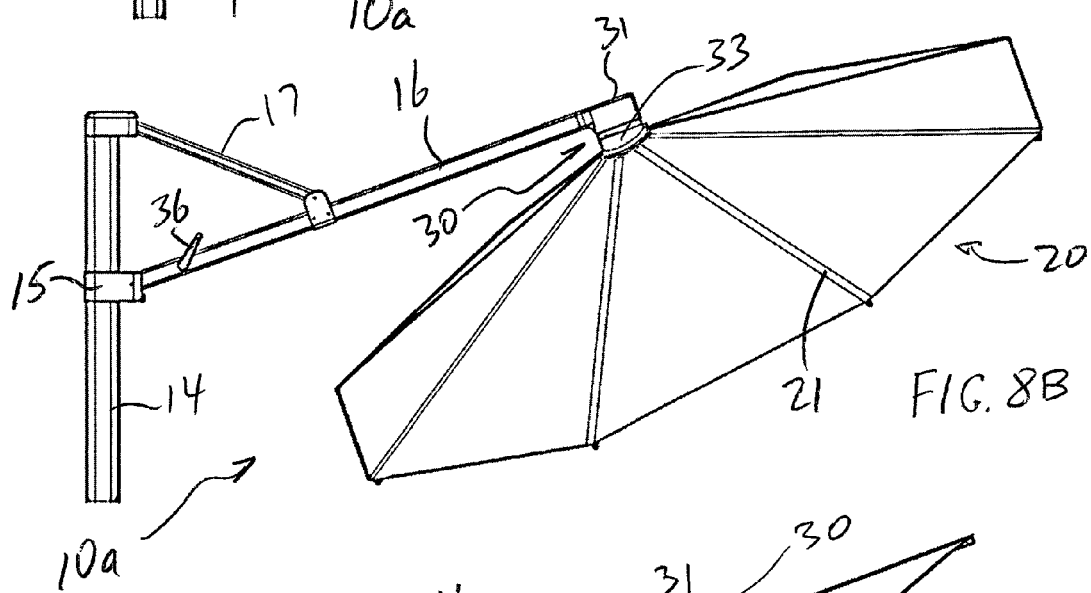
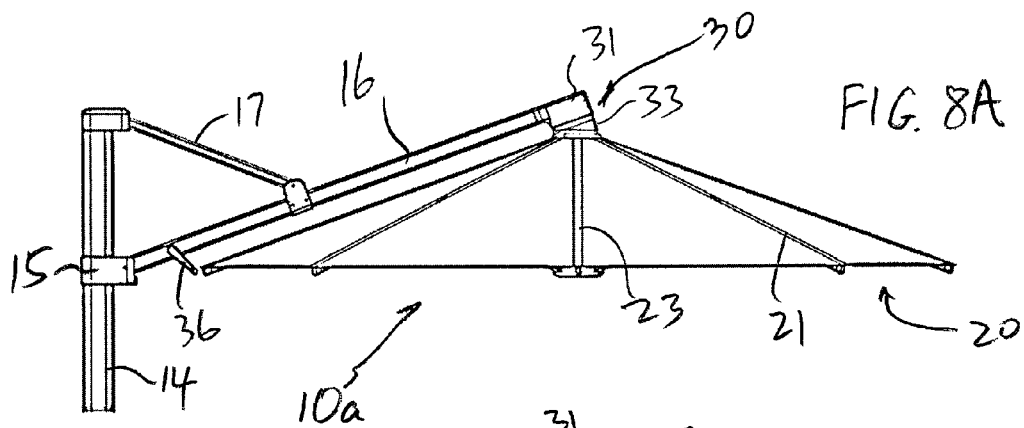












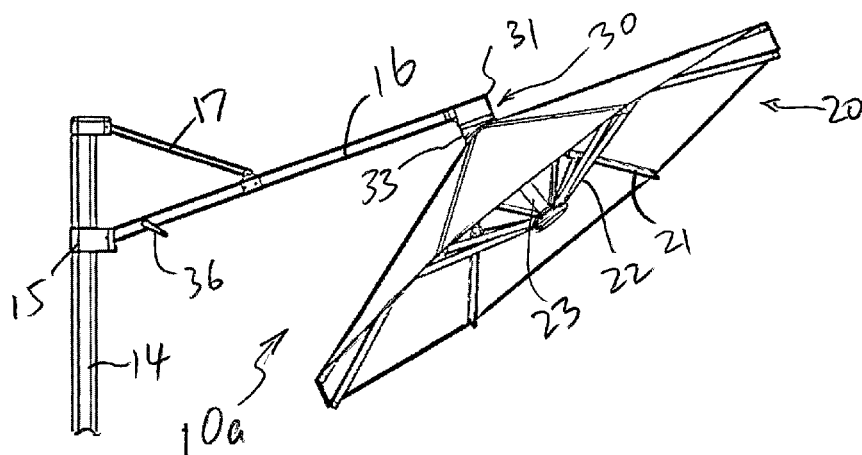


FIG. 8D

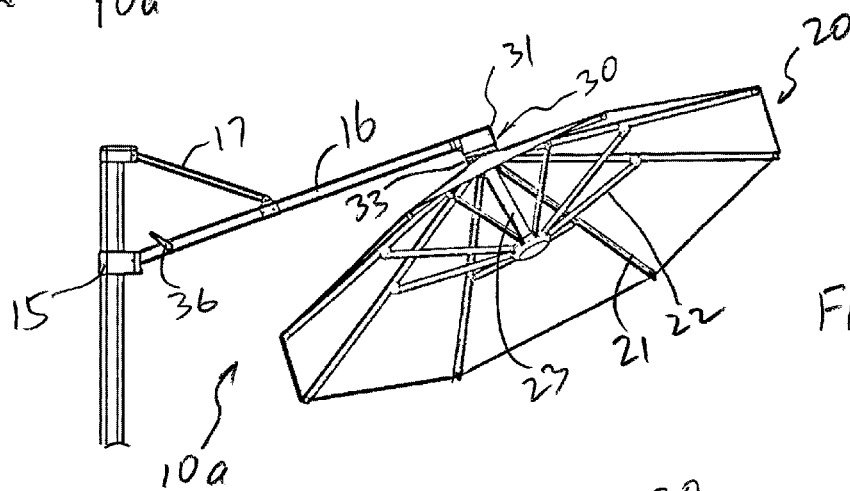


FIG. 8E

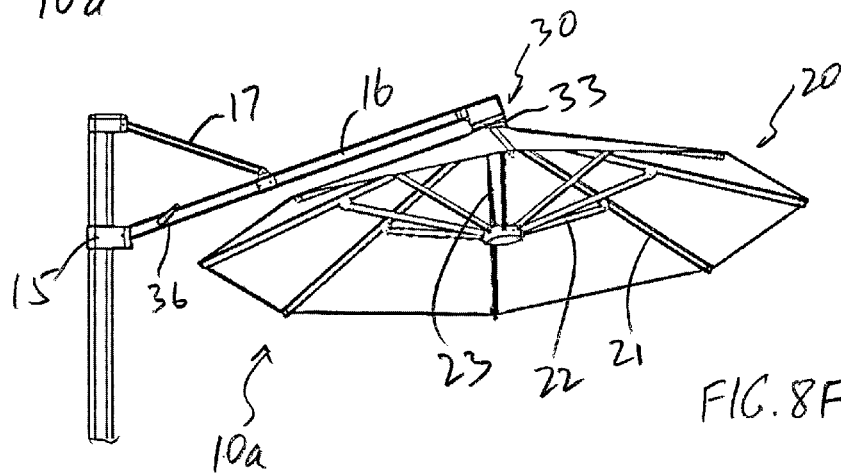
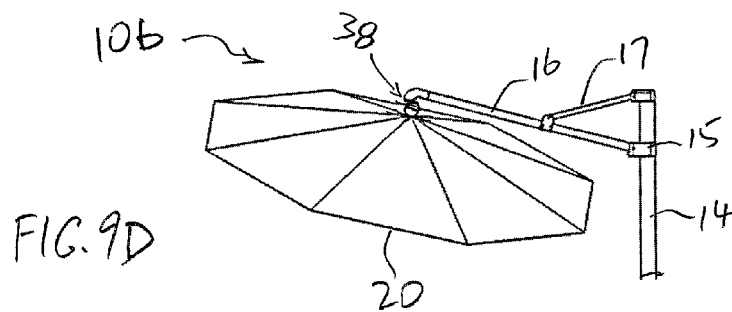
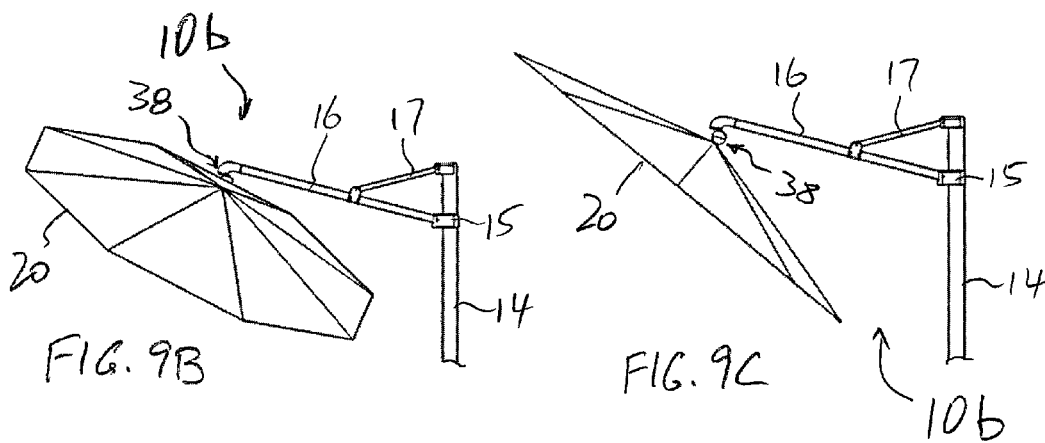
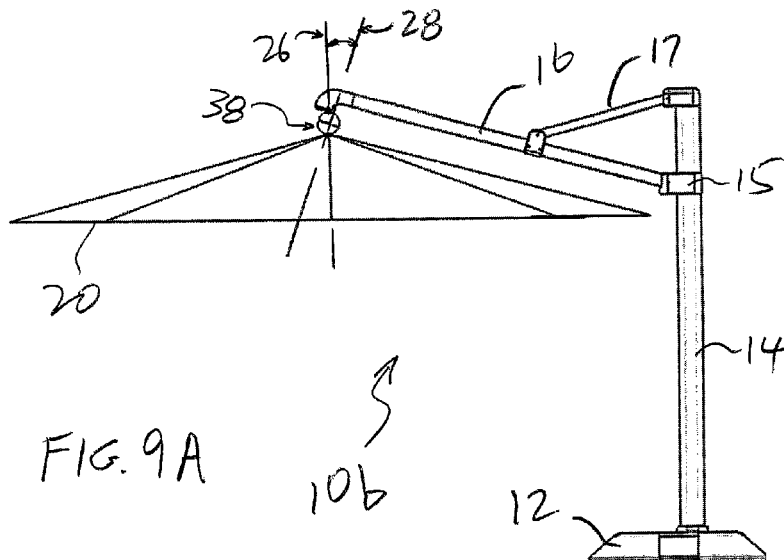


FIG. 8F





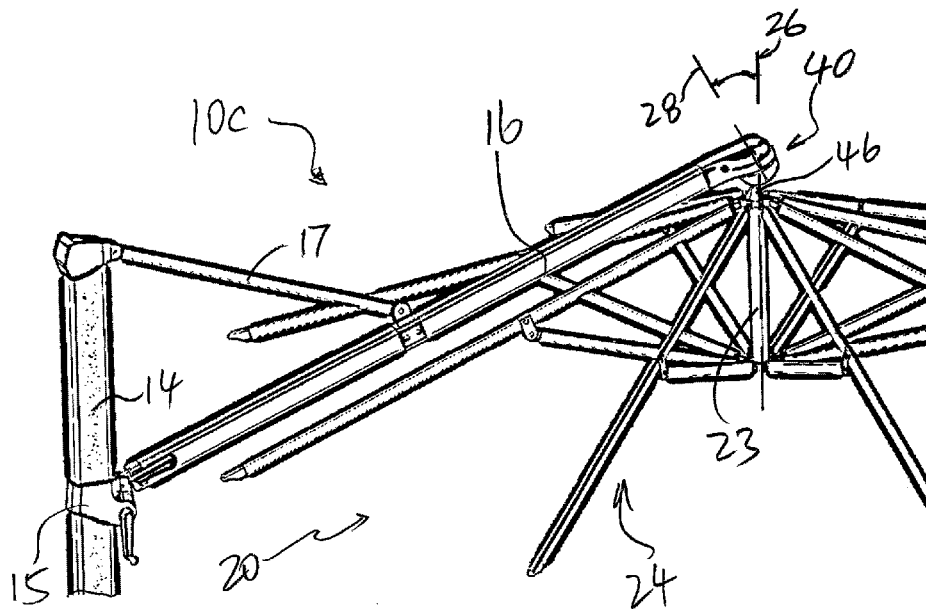


FIG. 10A

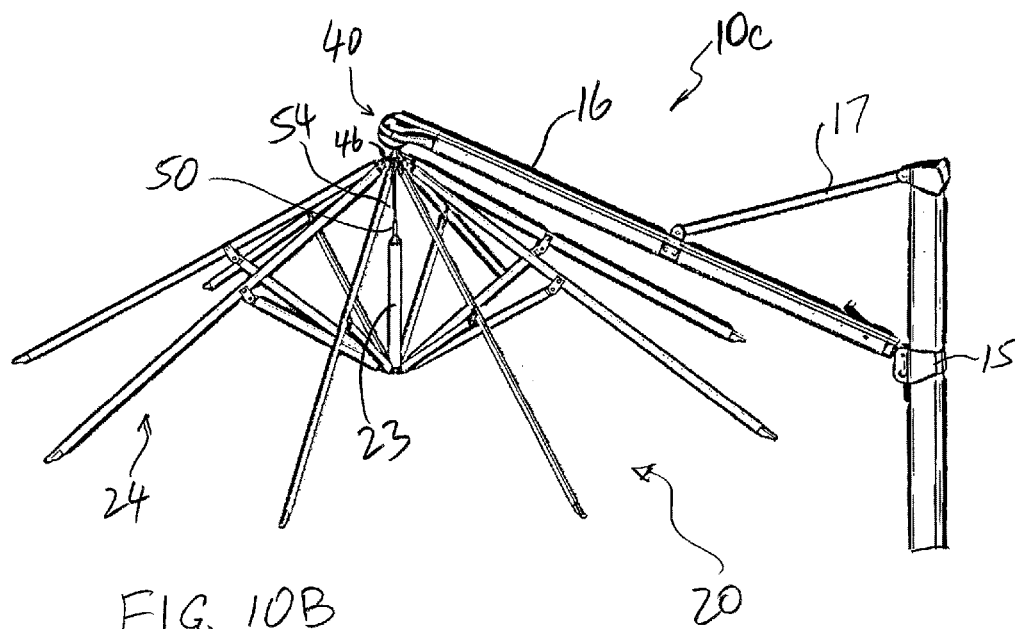
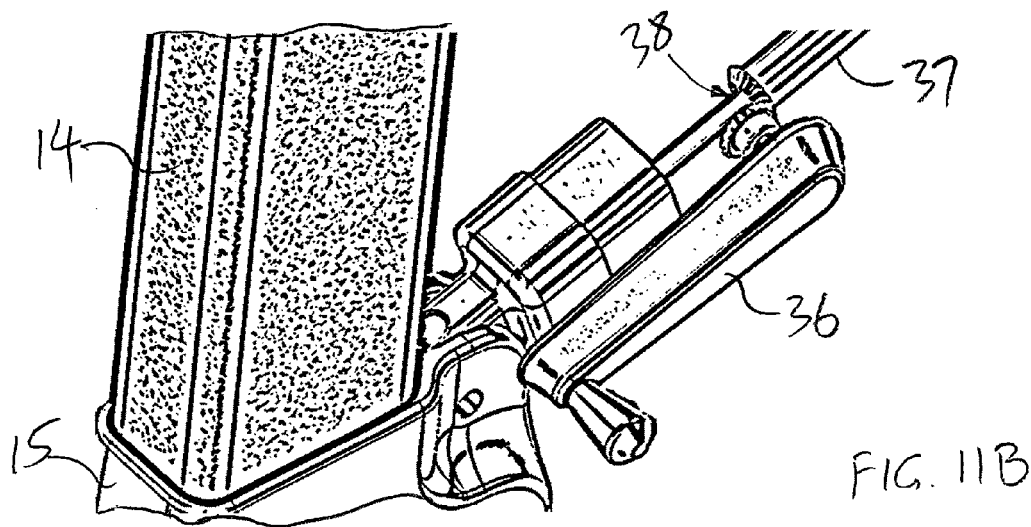
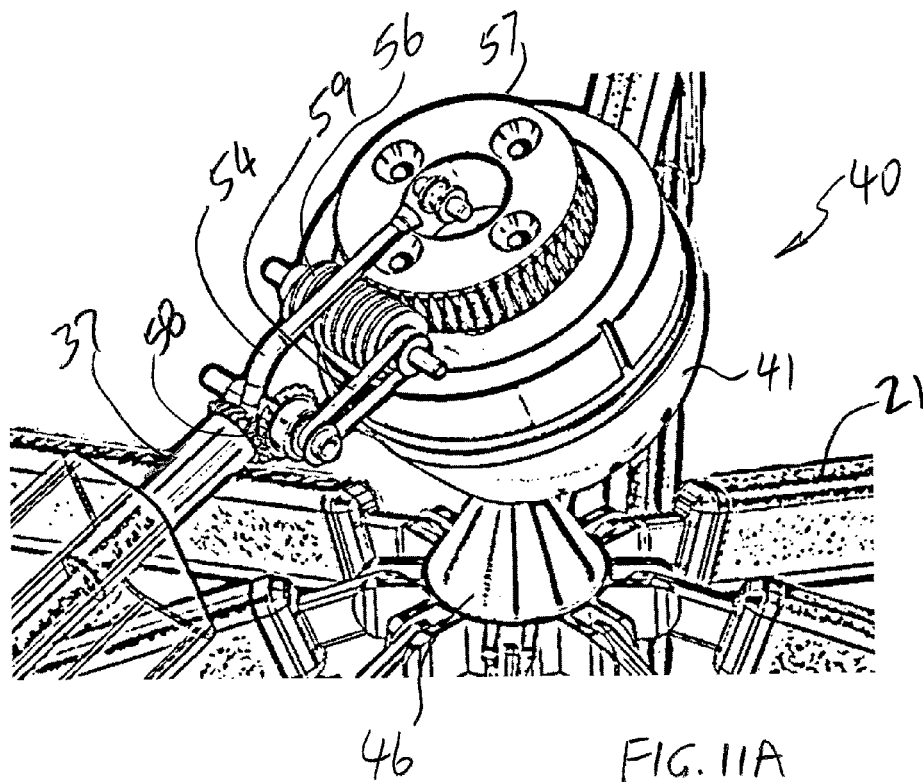
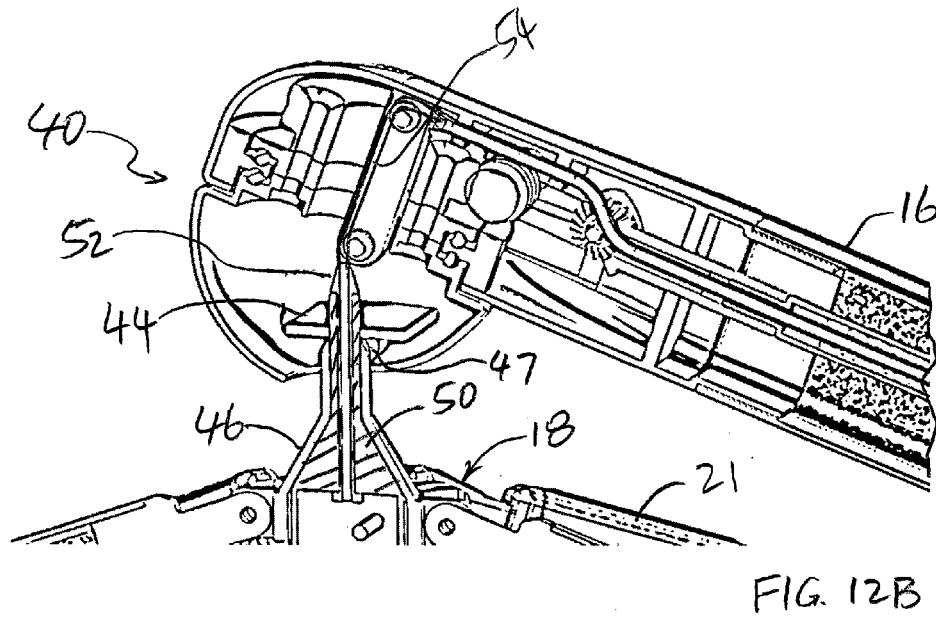
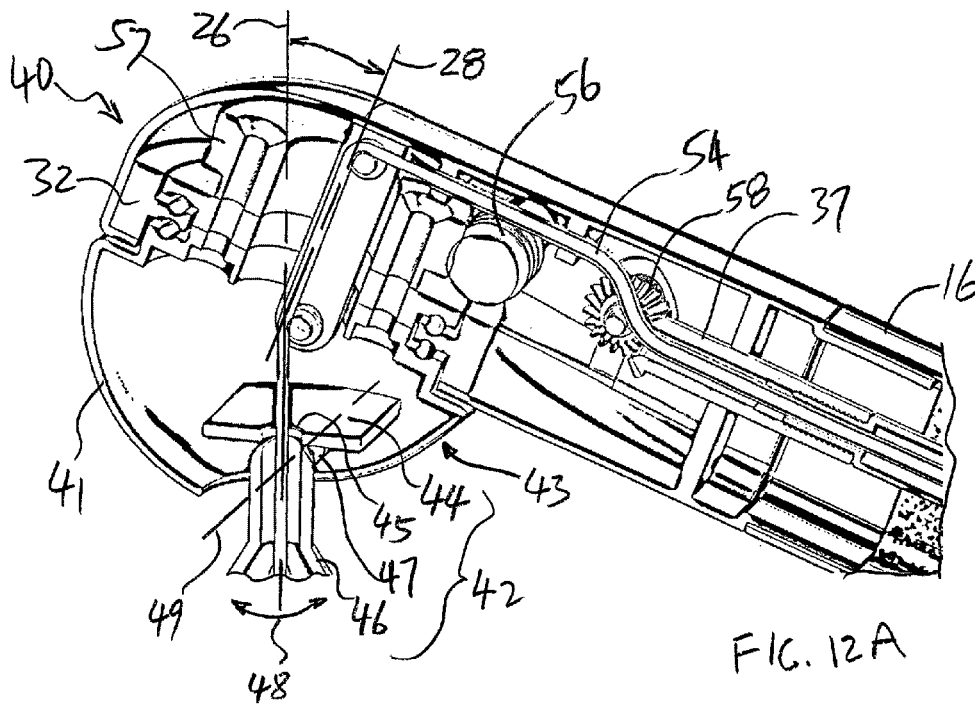


FIG. 10B





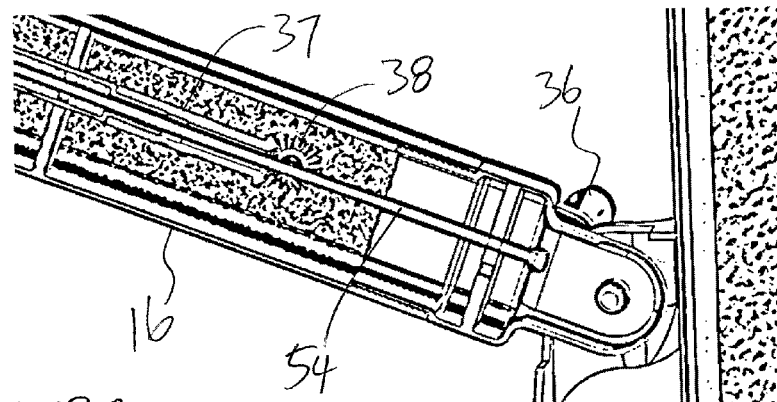


FIG. 12C

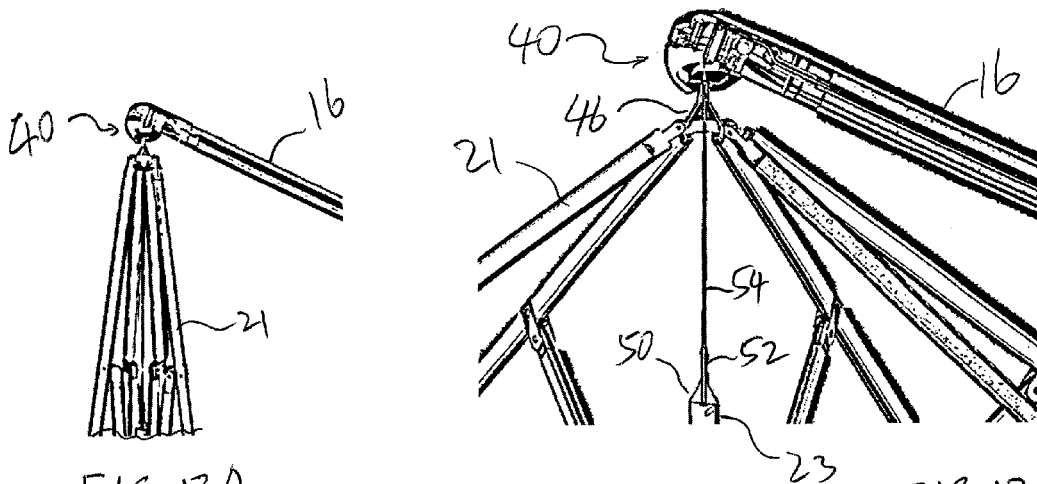


FIG. 13A

FIG. 13B

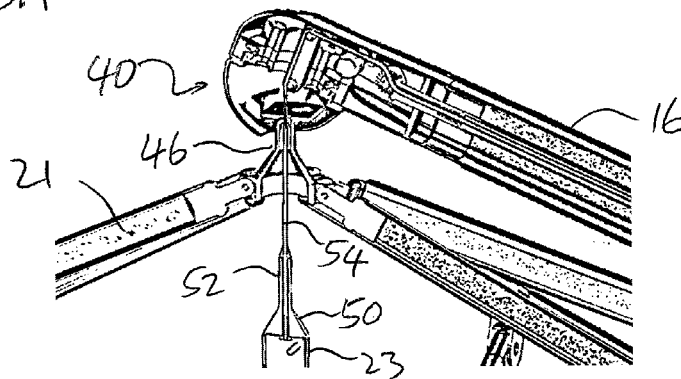


FIG. 13C

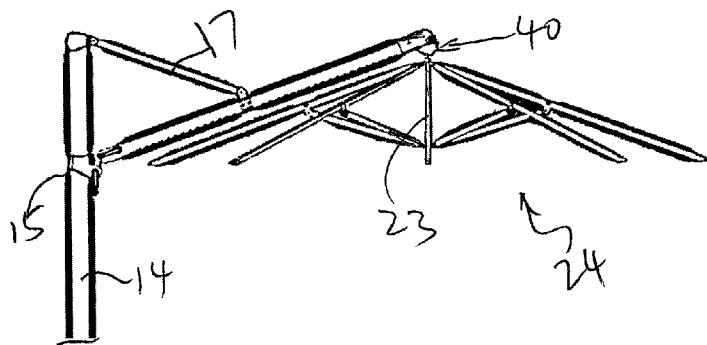


FIG. 14A

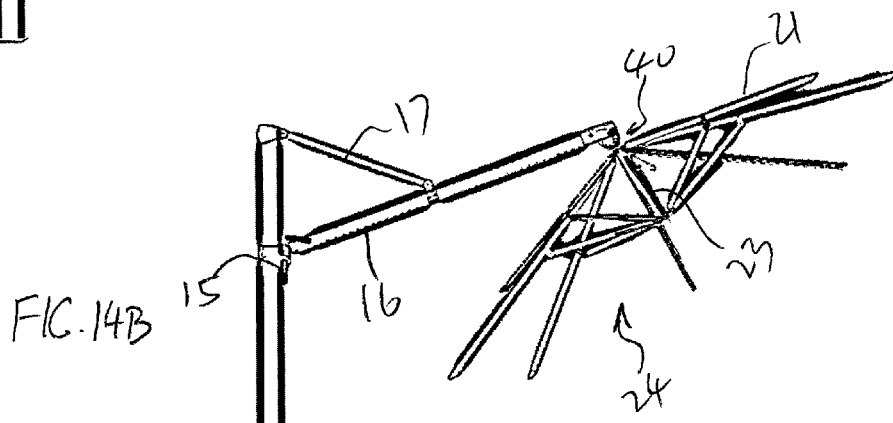


FIG. 14B

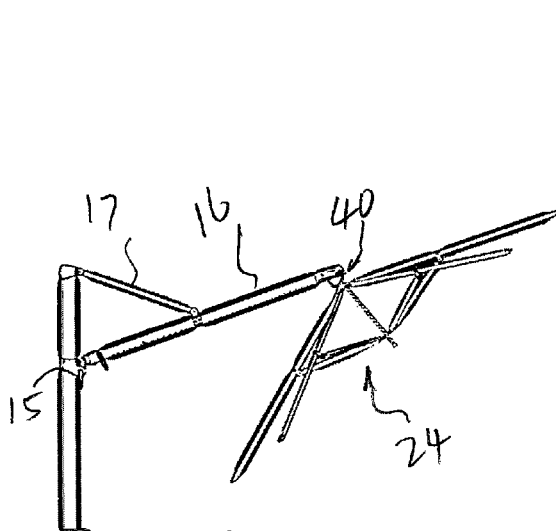


FIG. 14C

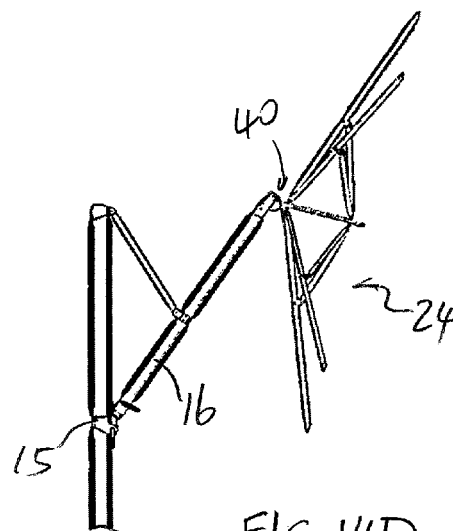
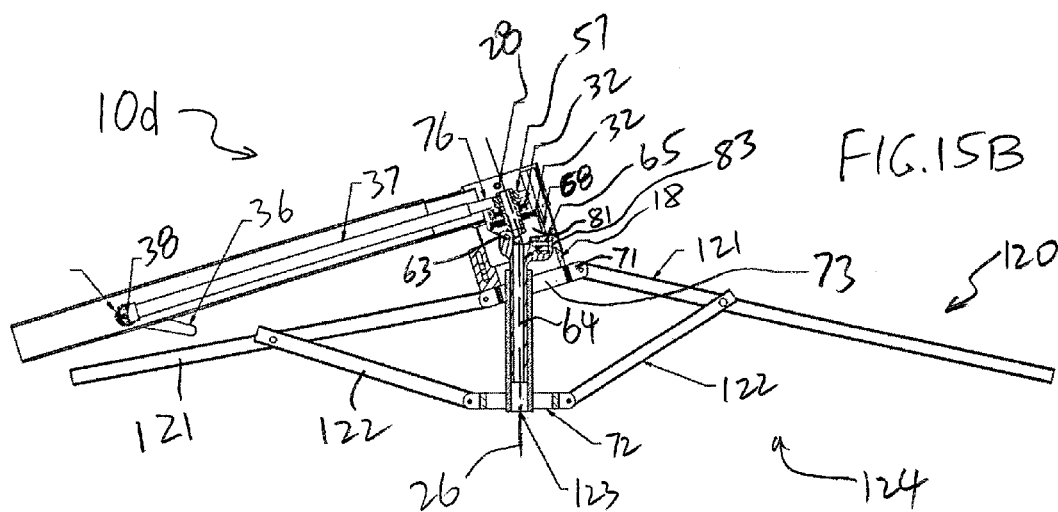
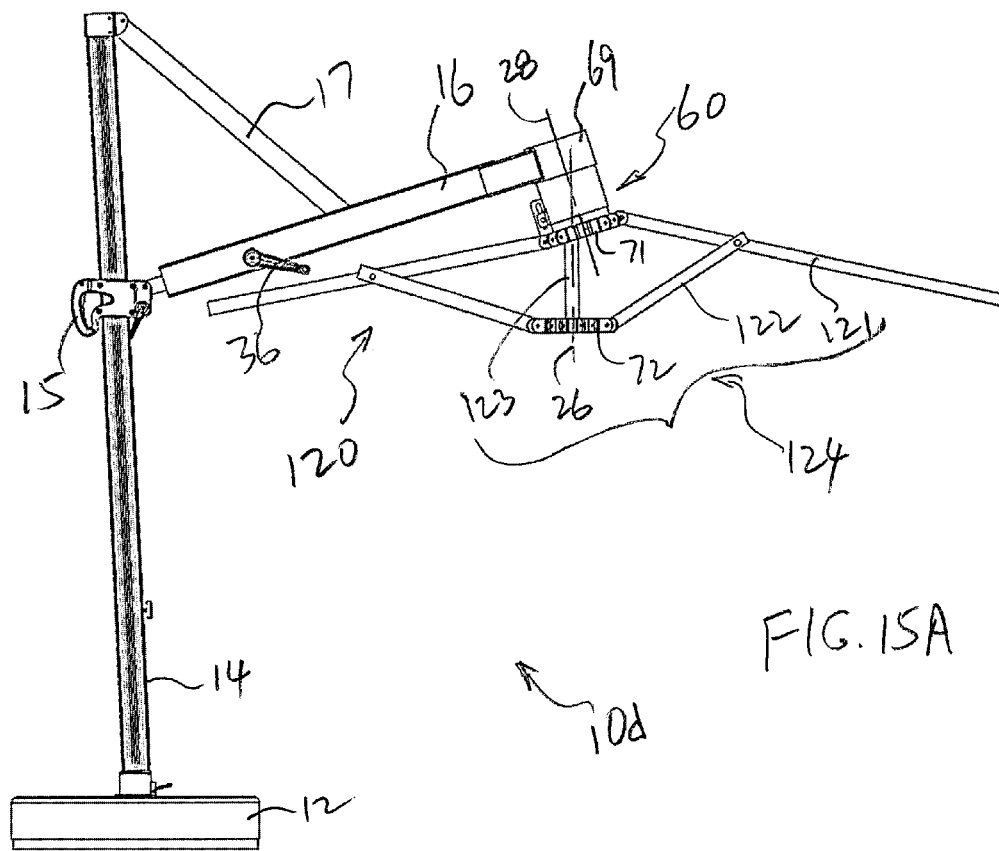


FIG. 14D



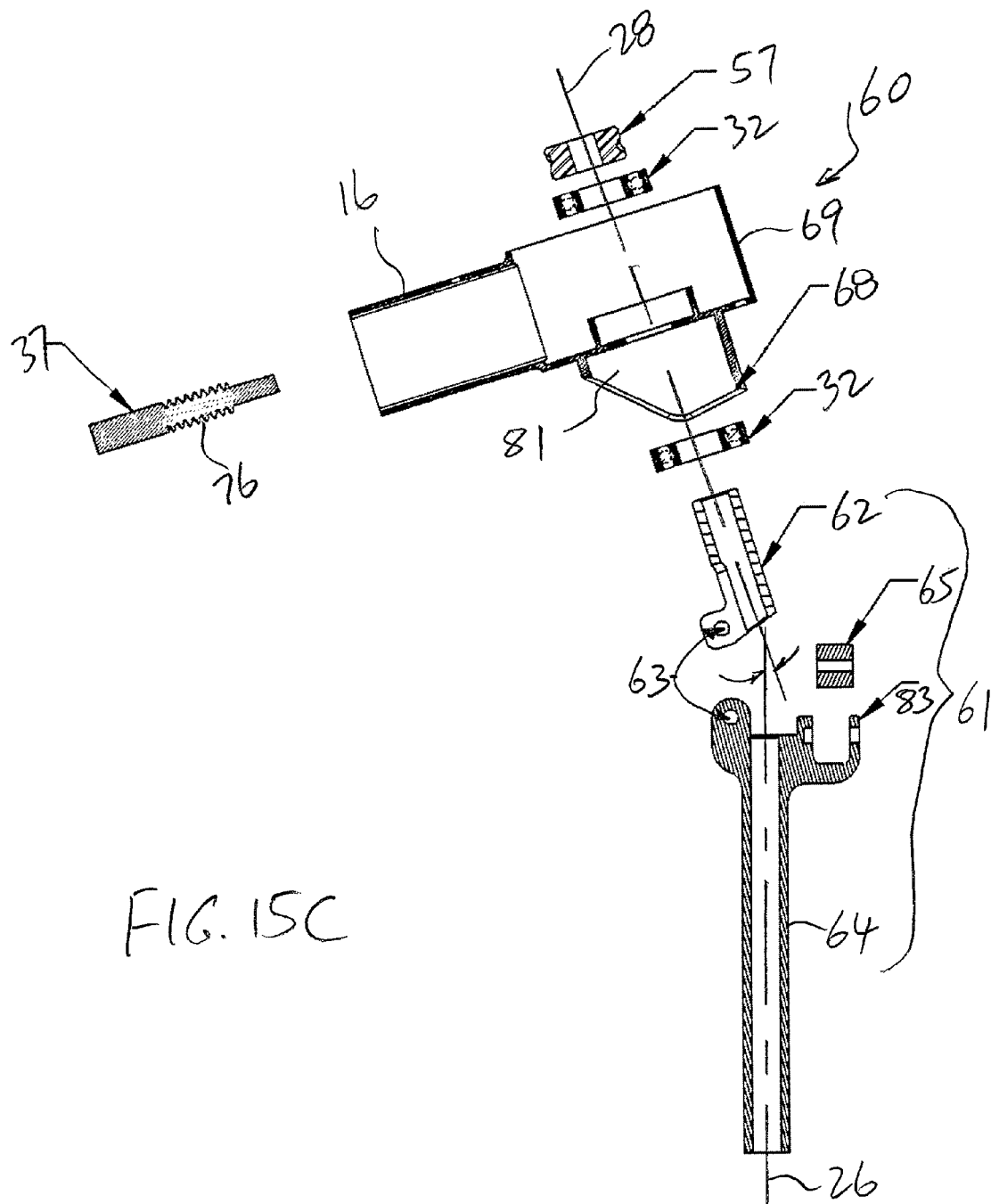
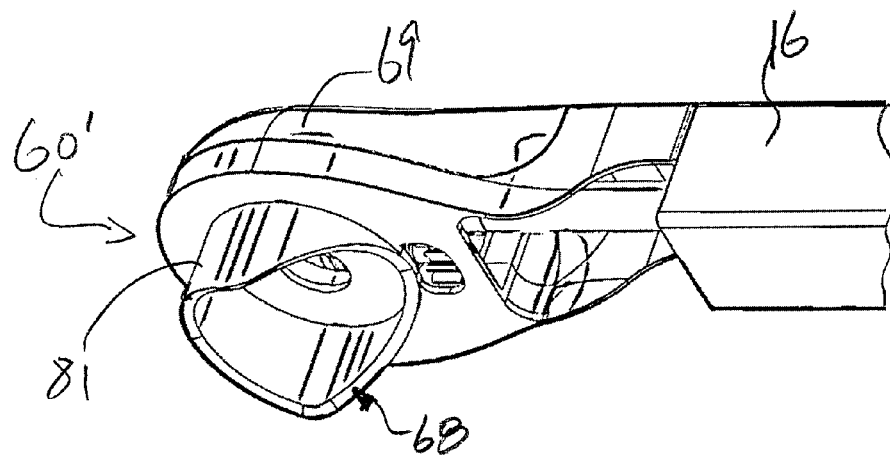
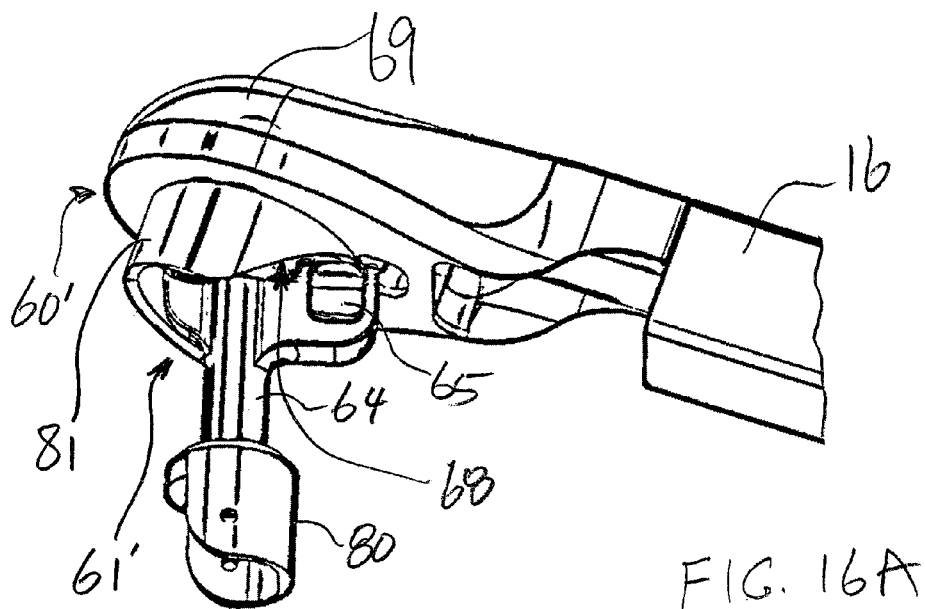


FIG. 15C





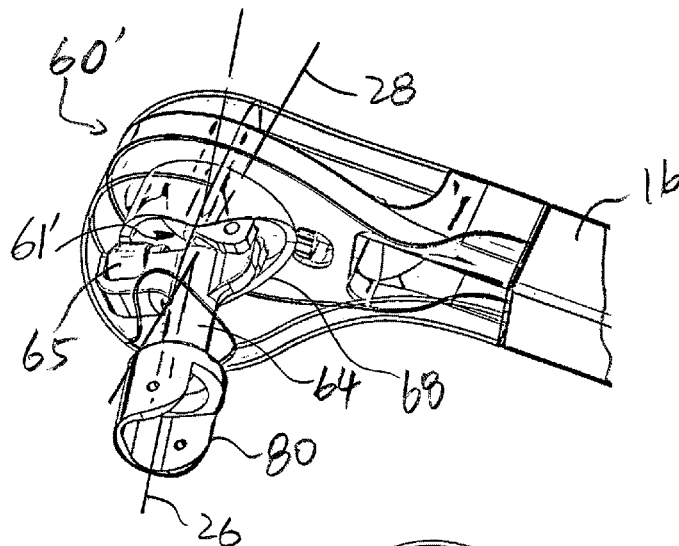


FIG. 17A

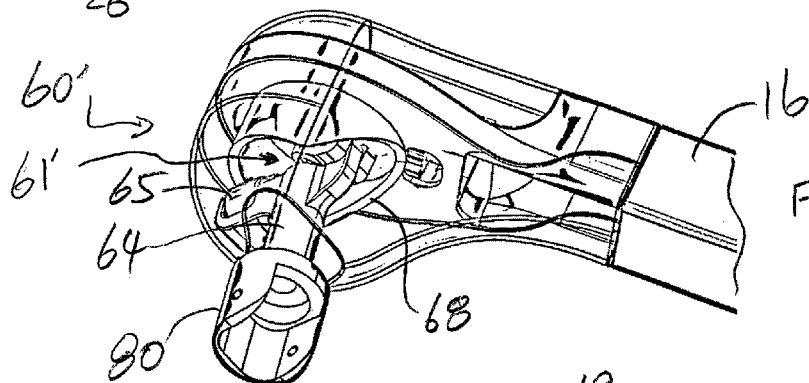


FIG. 17B

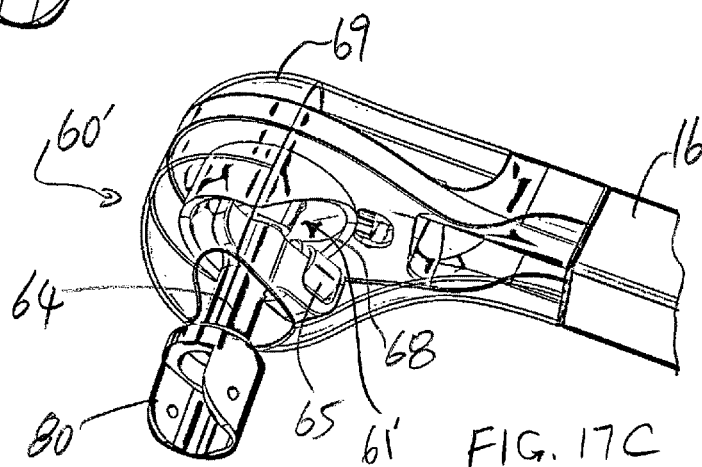


FIG. 17C

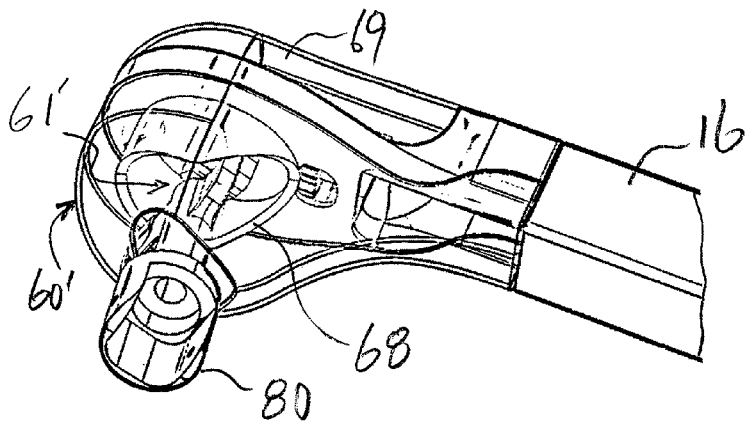


FIG. 17D

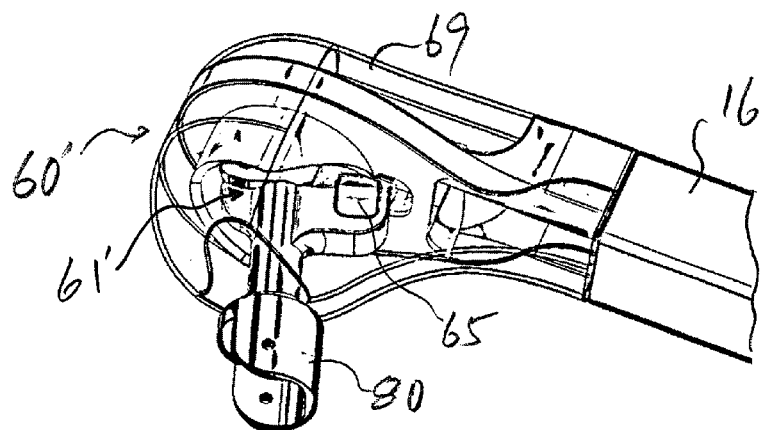


FIG. 17E

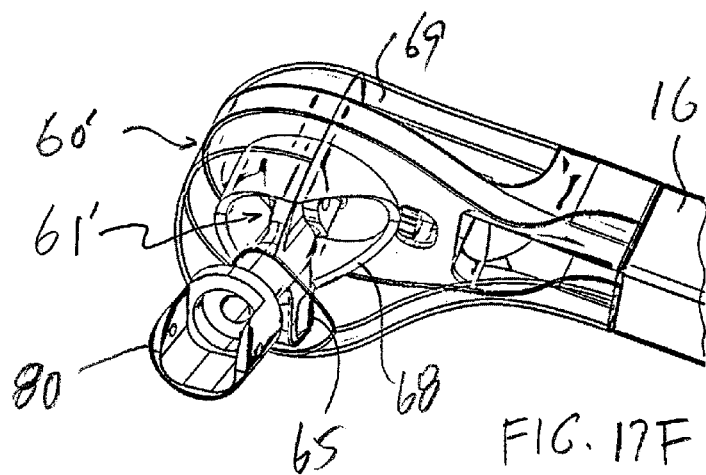
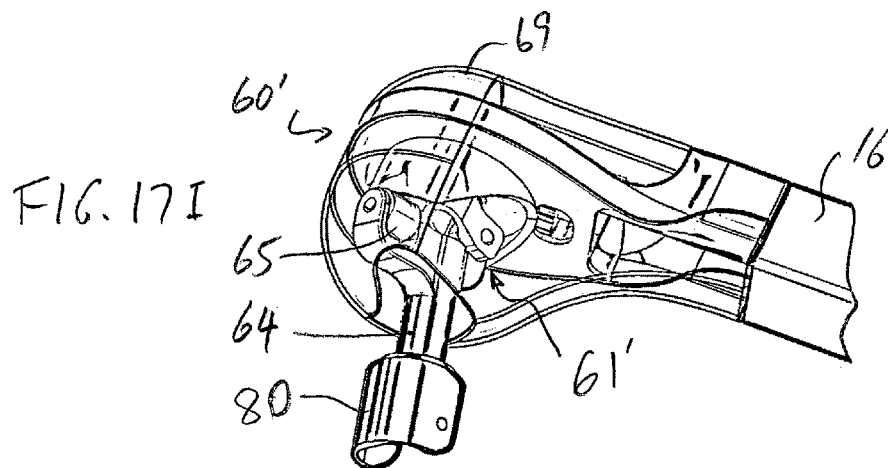
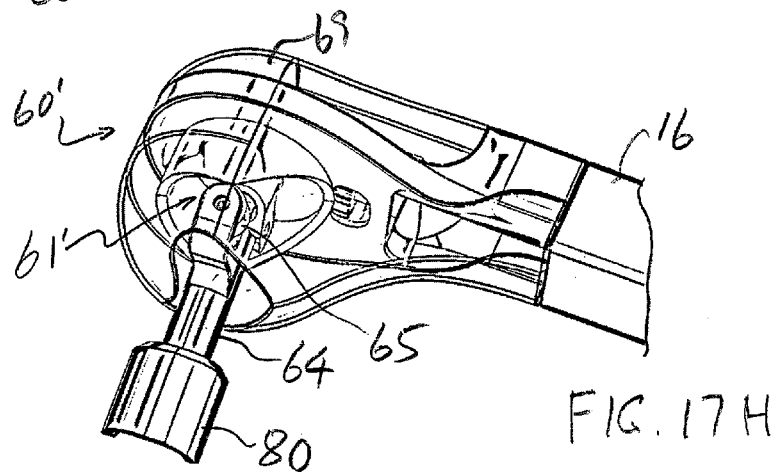
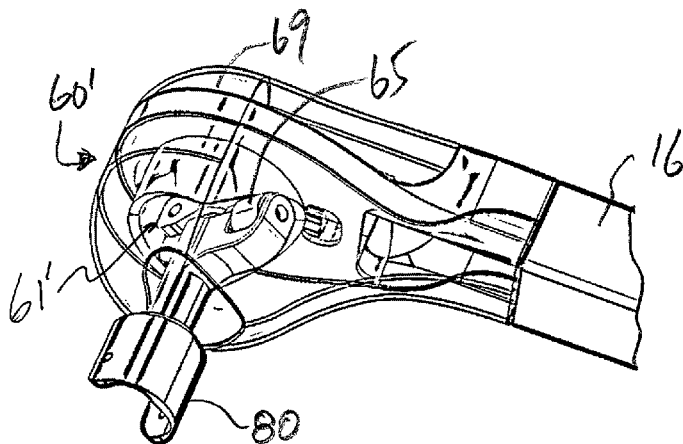
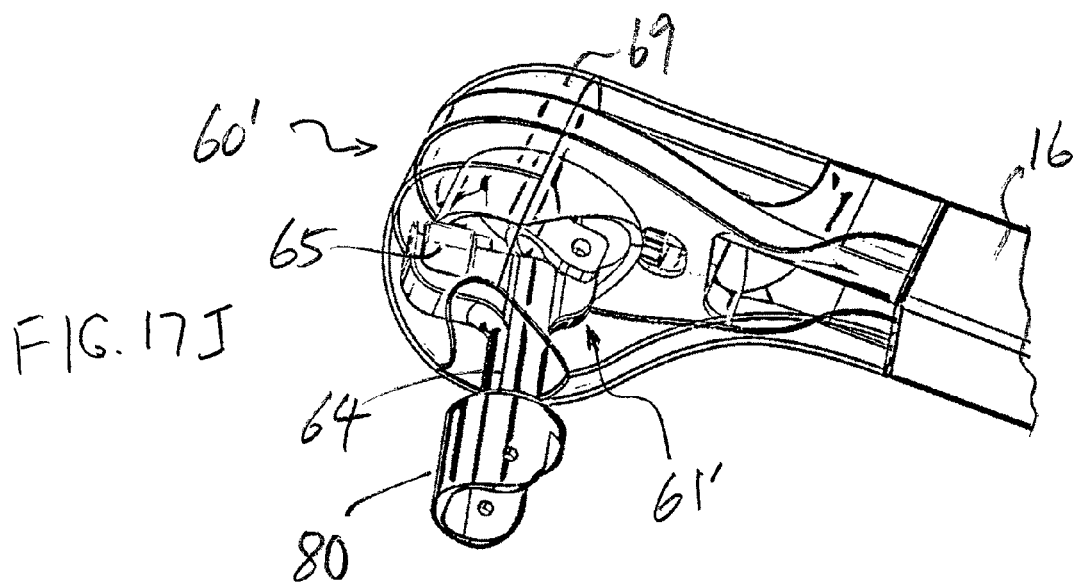


FIG. 17F





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# UMBRELLA HAVING A PIVOT JOINT TO PROVIDE ADDITIONAL DEGREES OF FREEDOM OF ORIENTATION OF ITS CANOPY

## PRIORITY CLAIM

This application claims the priority of U.S. Provisional Patent Application No. 61/778,281 filed on Mar. 12, 2013, which is fully incorporated by reference as if fully set forth herein. All publications noted below are fully incorporated by reference as if fully set forth herein.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention is directed to large size umbrellas, in particular umbrellas of the type having a canopy supported by a post.

### 2. Description of Related Art

Heretofore, large umbrellas, such as patio umbrellas, had been configured to allow the shade or canopy (e.g., comprising a fabric panel supported by rib frame structure) to be tilted at different angular positions or orientations with respect to a generally vertical support post. By being able to reposition the orientation of the canopy to the post, better coverage of the canopy can be achieved, to better shade the user from the sun (e.g., at different times of the day).

U.S. Pat. No. 6,014,980 to Glatz discloses a free-arm canopy having a side arm cantilevered from a vertical support post, and a canopy hanging from the extended end of the extended side arm. The side arm is rotatable about its axis. However, the Glatz free-arm canopy involves a rather complicated combination of structures to implement movement including rotation of the side arm to change the orientation of the canopy with respect to the support post. A combination of steps are required to manipulate a combination of structures in order to change the orientation of the canopy with respect to a fixed support post. In particular, the long extending side arm that supports the canopy needs to be rotated in order to change the orientation of the canopy. Given the canopy includes a metal frame and heavy fabric material, and the canopy extends from the end of the side arm, the weight of the canopy creates a rather heavy load to be maneuvered by the rotation of the side arm. As can be appreciated, the structure disclosed in the Glatz patent provides poor mechanical leverage for the rotation of the side arm to maneuver the dead weight of the canopy extending at the extended end of the side arm. Consequently, significant effort is required of the user in rotating the long side arm in order to tilt the load of the canopy hanging from the extended end of the side arm. In addition, given the rotation of the side arm, the degree of freedom of orientation of the canopy is limited to an arc about the side arm axis. Further, given the requirement of a rope that runs through the side arm for use to open/close the canopy, range of rotation of the side arm is therefore limited, thus limiting the range of orientations of the canopy. The degree of freedom of orientation of the canopy is thus severely limited.

For example, U.S. Pat. No. 6,840,253 to Ma, the inventor of the present invention, discloses a "side post umbrella" that includes a side arm supported by and cantilevered from a side support post. A shade hangs from the extended end of the side arm. The side arm is rotatable about its axis, thus tilting the shade to change its orientation with respect to the

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support post. A handle is provided at the supported end of the side arm, which provides improved leverage for the user to rotate the side arm.

There is a further need for a simple, reliable and easy to operate structure that provides better maneuverability and additional degrees of freedom of orientation of the canopy with respect to a support.

## SUMMARY OF THE INVENTION

The present invention overcomes the drawbacks in the prior art, by providing a pivot joint for tilting the canopy of an umbrella (e.g., a patio umbrella), which is reliable and easy to operate by a user. In accordance with the present invention, the support hub of a canopy is coupled to a support structure via a pivot joint that is structured and configured to allow swiveling and/or tilting of the canopy with ease by a user, in more than one plane and/or with more than one degree of freedom with respect to the support structure. With the pivot joint of the present invention, the orientation of the canopy (i.e., the direction of the axis of the canopy support hub) can be selectively positioned without requiring rotation of the support structure (e.g., an extending side arm) to which the canopy is coupled via the pivot joint.

In one aspect of the present invention, the canopy has a frame including a support hub (e.g., a crown, and/or a longitudinal central hub which may be in the form of a shaft, such as a runner of the canopy), and the pivot joint is rotatable about a rotation axis, wherein the axis of the canopy support hub makes a fixed or variable tilt angle with respect to the pivot joint rotation axis. As a result of the tilt angle between the pivot joint rotation axis and the canopy support hub axis. The rotation of the pivot joint causes tilting of the canopy support hub axis, thus tilting the canopy to change its orientation.

The extent of the tilt angle between the support hub and the pivot joint rotation axis in the pivot joint depends on one or more of the following considerations: size of the canopy, extent of the opening of the canopy, weight of the canopy, range of orientations of the canopy (i.e., the range of directions of the support hub axis), orientation of the pivot joint rotation axis with respect to the supporting structure (e.g., the side arm to which the pivot joint is supported), position of the side arm, and/or desired application of the umbrella. Generally, such tilt angle can be less than greater than 0 degrees to about 45 degrees.

In one embodiment, the canopy support hub makes a fixed, non-zero tilt angle with respect to the pivot joint rotation axis. In one embodiment, the canopy rotates along with rotation of the pivot joint. In another embodiment, the canopy support hub make a variable tilt angle with respect to the pivot joint rotation axis. The canopy may or may not rotate along with the rotation of the pivot joint.

In one embodiment, the umbrella comprises a base supporting an upwardly (e.g., vertical or at an angle to the vertical) extending post (e.g., straight or curved). An arm extends at an angle and in a cantilevered manner from the post. The canopy is supported at or near the extended end of the arm, with the support hub of the canopy coupled to the arm via a pivot joint in accordance with the present invention. In one embodiment, the arm may be supported by a cantilever support that is slidable along the post. In addition, one or more support links may be provided between the arm and the post to improve stability of the extending arm. The canopy includes a collapsible frame (including a framework of long and short ribs and/or runners), and a flexible panel (e.g., made of a heavy fabric such as canvas) supported by

such frame. The shade can be open to provide shading or closed for storage, by manipulating the frame. The canopy may be symmetrical about the center support hub of the canopy.

#### BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature and advantages of the invention, as well as the preferred mode of use, reference should be made to the following detailed description read in conjunction with the accompanying drawings. In the following drawings, like reference numerals designate like or similar parts throughout the drawings.

FIG. 1 is a perspective view illustrating a patio umbrella having a pivot joint in accordance with one embodiment of the present invention.

FIG. 2 is a sectional view of the patio umbrella in FIG. 1.

FIG. 3 is a side view of the patio umbrella in FIG. 1.

FIG. 4 is an exposed perspective view illustrating a canopy having a pivot joint in accordance with one embodiment of the present invention.

FIG. 5 is an enlarged perspective view of the pivot joint of FIG. 4.

FIG. 6 is perspective view illustrating the crank handle end of the gear drive, in accordance with one embodiment of the present invention.

FIGS. 7A-7C are sectional views illustrating the orientations of the canopy frame with rotation of the pivot joint of the embodiment of FIG. 4.

FIGS. 8A-8F are perspective views illustrating the canopy at a series of orientations with rotation of the pivot joint of the embodiment of FIG. 4.

FIGS. 9A-9D illustrate orientations of a patio umbrella having a pivot joint in accordance with another embodiment of the present invention.

FIGS. 10A-10B illustrate a patio umbrella having a pivot joint in accordance with a further embodiment of the present invention.

FIG. 11A is an enlarged view illustrating the pivot joint of the embodiment of FIG. 10;

FIG. 11B is a partial open view illustrating the crank handle end of the gear drive, in accordance with one embodiment of the present invention.

FIGS. 12A-12B are sectional views illustrating the pivot joint of the embodiment of FIG. 10; FIG. 12C is a sectional view illustrating the crank handle end of the gear drive, in accordance with one embodiment of the present invention.

FIGS. 13A-13C illustrate the sequence of opening of the canopy of the embodiment of FIG. 10.

FIGS. 14A-14C illustrate orientations of the canopy frame with rotation of the pivot joint of the embodiment of FIG. 10; FIG. 14D illustrates further tilting of the canopy with a change of position of the cantilevered arm.

FIG. 15A is a schematic side view illustrating a patio umbrella having a pivot joint in accordance with a still further embodiment of the present invention; FIG. 15B is a schematic sectional view of the canopy of FIG. 15A; FIG. 15C is an exploded schematic sectional view of the pivot joint of FIG. 15B.

FIG. 16A is a perspective view illustrating a pivot joint in accordance with yet another embodiment of the present invention; FIG. 16B is a perspective view of the cam structure in the pivot joint of FIG. 16A.

FIGS. 17A-17J illustrate the angles of a tilt joint axle with rotation of the flex joint axle of the pivot joint in FIG. 16.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention is described below in reference to various embodiments with reference to the figures. While this invention is described in terms of the best mode for achieving this invention's objectives, it will be appreciated by those skilled in the art that variations may be accomplished in view of these teachings without deviating from the spirit or scope of the invention.

The present invention overcomes the drawbacks in the prior art, by providing a pivot joint for tilting the canopy of an umbrella (e.g., a patio umbrella), which is reliable and easy to operate by a user. In accordance with the present invention, the support hub of a canopy is coupled to a support structure via a pivot joint that is structured and configured to allow swiveling and/or tilting of the canopy with ease by a user, in more than one plane and/or with more than one degree of freedom with respect to the support structure. With the pivot joint of the present invention, the orientation of the canopy (i.e., the direction of the axis of the canopy support hub) can be selectively positioned without requiring rotation of the support structure (e.g., an extending side arm) to which the canopy is coupled via the pivot joint. The orientation of the canopy is generally the direction at which the axis of the canopy support hub is pointed.

The present invention will be described herein-below in reference to umbrellas of the type designed and structured for use to provide shade to a relatively large area, such as in a garden or patio area. This type of umbrellas are generally referred to as patio umbrellas. However it is understood that the present invention could be applied to umbrellas for other applications, currently known or future discovered, without departing from the scope and spirit of the present invention.

FIG. 1 is a perspective view illustrating a patio umbrella having a pivot joint in accordance with one embodiment of the present invention. FIG. 1 also is a general illustration of some of the components of a patio umbrella in accordance with one embodiment of the present invention. The illustrated general structure of the patio umbrella is also applicable to other embodiments of the invention discussed herein below.

In the illustrated embodiment, the umbrella 10a generally comprises a base 12 supporting an upwardly (e.g., vertical or at an angle to the vertical) extending post 14 (e.g., straight or curved). An arm 16 extends at an angle and in a cantilevered manner from the post 14. The canopy 20 is supported at or near the extended end of the arm 16, with the crown 18 at the apex region of the canopy 20 (i.e., the canopy support hub in this embodiment) pivotally coupled to the arm 16 via a rotatable pivot joint (as further elaborated below in connection with various embodiments) in accordance with the present invention. In one embodiment, the non-extended end of the arm 16 may be hingedly or pivotally supported by a cantilever support 15, which position may be adjusted along the post 14 (e.g., the cantilever support 15 is slidable along the post 14). In addition, one or more support links 17 may be provided between and hingedly or pivotally coupled to the arm 16 and the post 14 to improve stability of the extending arm 16. The canopy 20 generally includes a collapsible frame 24 (which may include a framework of long ribs 21, short ribs 22, and a support hub, such as a runner 23), and a shade 25 comprising a flexible panel (e.g., made of a heavy fabric such as canvas) supported by such frame 24. The shade 25 can be opened (as in the state illustrated in FIG. 1) to provide shading, or closed for storage, by manipulating the frame 24. The

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canopy frame **24** may be symmetrical about the axis of the canopy's longitudinal central support hub (which may be the runner in some embodiments), which is generally aligned with the pivot joint at the crown of the canopy, and generally to the center of mass or gravity of the canopy **24**.

In one embodiment, the canopy support hub makes a fixed, non-zero tilt angle with respect to the pivot joint rotation axis. The canopy rotates along with rotation of the pivot joint. As a result of the fixed angle between the pivot joint rotation axis and the canopy support hub axis. The rotation of the pivot joint causes tilting of the canopy support hub axis, thus tilting the canopy to change its orientation.

In particular, in the embodiment of FIGS. 2-6, the pivot joint **30** rotates about an axis **28**, which in this embodiment is a fixed axis in reference to the supporting arm **16**. In accordance with the illustrated embodiment, the crown **18** of the canopy **25** is attached to the pivot joint **30**, so that it rotates along with rotation of the pivot joint **30**. The canopy support hub axis **26** makes a fixed, non-zero tilt angle with respect to the pivot joint rotation axis **28**.

In the illustrated embodiment, the rotatable pivot joint **30** is supported to rotate in a joint housing **31** (more clearly shown in FIGS. 4 and 5). In the illustrations, the rotatable pivot joint **30** is generally cylindrical, but may take on any shape without departing from the scope and spirit of the present invention. To facilitate rotation, support bearings **32** (e.g., roller bearings; which may share similar structure as the support bearing assemblies shown in embodiment of FIG. 12A and FIG. 15C) are provided in the housing to rotatably support the pivot joint **30**, to facilitate its rotation with respect to the external housing **31**. As shown in the drawings, the rotatable pivot joint **30** supports the canopy in a manner such that the pivot joint rotation axis **28** makes a non-zero tilt angle with respect to the canopy support hub axis **26**. In other words, the pivot joint rotation axis **28** is not in line with and/or not parallel to the canopy support hub axis **26**. In the illustrated embodiment, this fixed tilt angle is predetermined, defined and fixed by the wedge-shape interface structure **33** between the pivot joint **30** and the canopy crown **18**.

As can be appreciated from the drawings, given the tilt angle between the pivot joint rotation axis **28** and the canopy support hub axis **26**, as the pivot joint **30** rotates about its axis **28**, the canopy **20** is rotated along with the rotation of the pivot joint **30**, thus causing the canopy support hub axis **26** to tilt (in particular, the axis **26** rotates about axis **30**, prescribing a path corresponding to the surface of a cone with axis **28**). As a result, the canopy **20** changes its orientation with respect to the supporting arm **16**, as more clearly shown in the various orientations illustrated in FIGS. 7A to 7C (the shade is omitted from view, so as to more clearly show the relative position of the canopy frame **24** to the arm **16**). FIGS. 8A-8F are perspective views illustrating the canopy **20** at various orientations with rotation of the pivot joint **30**.

Accordingly, unlike the prior art configurations, the orientation of the canopy **20** can be changed without requiring rotation of the supporting arm **16** from which the canopy **20** is supported at its extended end. Further, unlike the prior art, the orientation of the canopy **20** can vary in more than one plane and/or with more than one degree of freedom with respect to the support arm **16**, given that the axis **26** can be essentially swiveled in space, not confined to movement within a particular plane.

In one embodiment, the pivot joint **30** is structured to freely rotate about its axis **28** when the canopy **20** is manipulated by a user (e.g., turning the canopy about the

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joint axis **28**) to pivot or tilt the canopy to a desired orientation. In the illustrated embodiment, to facilitate user rotation of the canopy **20**, the rotation of the pivot joint **30** is facilitated by a drive mechanism. As more clearly shown in FIG. 5, the drive mechanism comprises gears, such as an arrangement of a circular rack gear **34** and a pinion gear **35** at the top of the pivot joint **30**. Other types of drive mechanisms (e.g., worm gears, as in other embodiments discussed below) may be provided without departing from the scope and spirit of the present invention. For example, the drive mechanism could be implemented by a system comprising shafts, pulleys, belts, chains and/or cables, etc., in alternative or in addition to gears (see, e.g., FIG. 11A). The drive mechanism thus provides a tool to provide leverage for facilitating a user to manually actuate the drive mechanism to rotate the pivot joint **30**. This tool may be in the form of a crank handle, a lever, a dial pad, or other structures that facilitates rotation of gears and/or drive shaft. Referring also to FIG. 6, the tool includes a crank handle **36** coupled to a drive shaft **37** by a bevel gear drive **38** at the adjacent end of the drive shaft **37**. The drive shaft **37** is rotatably supported within hollow arm **16**. The other distal end of the drive shaft **37** supports the pinion gear **35** that drives the rack gear **34** to rotate the pivot joint **30** (FIG. 5). By the user turning the crank handle **36**, the pivot joint **30** is rotated, as is more clearly shown in FIGS. 7A-7C. In the alternative or in addition, though not shown, the drive mechanism may be actuated by a motor drive, or a combination of manual drive and motor drive, replacing the crank handle **36**.

Further, a drawstring may be provided to connect to the runner **23** of the canopy frame **24**, to facilitate opening and closing of the canopy **20**. Such drawstring is not specifically shown in the illustrated embodiment, but may be similar in structure to the embodiments discussed below.

FIGS. 9A-9D illustrate orientations of a patio umbrella **10b** having a pivot joint in accordance with another embodiment of the present invention. The structure of the patio umbrella **10'** is generally similar to the structure of the patio umbrella **10a** in the previous embodiment, with the exception of differences pertaining to the pivot joint **38**. The pivot joint **38** can be a simple ball-and-socket configuration, which is schematically illustrated in the drawings. With the ball-and-socket type pivot joint **38**, it need not be confined to rotation about a particular fixed axis in reference to the supporting arm **16**. The pivot joint **38** can provide swiveling about the socket, thus allowing for a larger range of orientations of the canopy **20**. Instead of manual rotation of the canopy **20** about the pivot joint **38**, a similar gear drive mechanism may be provided to rotate the ball in the pivot joint **38**, though this would limit the pivot joint **38** to rotation about a fixed axis **28** with respect to the canopy support hub axis **26**, as shown in FIG. 9A.

FIGS. 10A-10B illustrate a patio umbrella **10c** having a pivot joint in accordance with a further embodiment of the present invention. The structure of the patio umbrella **10c** is generally similar to the structure of the patio umbrella **10a** and/or **10b** in the previous embodiments, with the exception of differences pertaining to the pivot joint **40** illustrated in FIGS. 11A-B and FIGS. 12A-12C. This embodiment improves on the structure of the pivot joint **30** in the previous embodiment, as it further includes a disengageable anchor coupling **42** between the support hub of the canopy **20** and the pivot joint **40**. This anchor coupling **42** provides more flexibility to allow the canopy support hub to be

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rotated towards the arm 16 when the canopy 20 is in the closed state, so as to facilitate stowing the canopy when it is not being used.

Referring to FIGS. 12A and 12B, the pivot joint 40 (comprising the gear 57 fixedly connected to the shell 41) is rotatable about the axis 28, with supporting bearings 32 within the housing 31. Specifically, the gear 57 and the shell 41 of the pivot joint 40 is rotatable on the bearings 32, with respect to the base of the pivot joint attached to the side arm 16. FIG. 12A shows the state of the anchor coupling 42 when the canopy 20 is in the fully closed or partially opened/closed position (i.e., corresponding to the states illustrated in FIGS. 10B, 13A and 13B). The anchor coupling 42 comprises an anchor support 44 and an anchor guide 46, and a disengageable anchor 50. In the illustrated embodiment, the anchor support 44 is securely attached to the pivot joint 40 (e.g., fixedly attached to the shell 41), in the form of a plate having an opening 45. The anchor guide 46 is partially shown in FIGS. 12A and 12B, but fully shown in FIGS. 12B, 13B and 13C. The anchor guide 46 connects to or may be part of the crown 18 of the canopy 20. The long ribs 21 of the canopy frame 24 may be pivotally connected to the anchor guide 46, as illustrated. The anchor guide 46 is pivotally supported by at a horizontal hinge 47 that is supported by the pivot joint 40 (e.g., by the shell 41), so that the anchor guide 46 can pivot/swing along arc 48 about the axis 49 of the hinge 47 (i.e., towards and away from the arm 16). The generally hemispherical shell 41 is provided with appropriate cutout 43 to allow for the pivotal movements of the anchor guide 46. The anchor guide 46 has a hollow interior cavity, which is sized and shaped to receive a matching anchor 50 that is complementarily sized and shaped (as shown in FIG. 12B).

Referring also to FIGS. 10B and 13C, the anchor 50 is attached to the top end of the central canopy support hub or runner 23. FIG. 12B illustrates the state of the anchor coupling 42 when the canopy 20 is fully opened. The anchor 50 is received in the anchor guide 46, with the extended anchor pin 52 of the anchor 50 inserted through the end of the anchor guide 46, and into the opening 45 in the anchor support 44. A drawstring connects to the anchor 50. Referring to FIGS. 10B, 13A to 13C, by pulling on the drawstring 54, the runner 23 is raised to open the canopy frame 24, thereby engaging the anchor pin 52 against the anchor support 44. More specifically, in operation, as the drawstring 54 is pulled upwards to raise the runner 23, it pivots the short ribs 22 to spread the long ribs 23 in the canopy frame 24, thereby opening the frame 24 and thus the shades 25 of the canopy 20. At the same time, the anchor pin 52 is received in the opening in the anchor support 44, thereby engaging the anchor pin 52 to the anchor support 44. The anchor guide 46 essentially guides the anchor pin 52 to engage the opening 45 in the anchor support 44. When the anchor pin 52 engages the anchor support 44, it locks the anchor guide 46 to prevent it from rotation about the hinge 47, thus preventing the canopy 20 from rocking (pivotal) movement about the hinge 47 when the canopy 20 is fully extended in use (e.g., when the wind blows). As the drawstring 54 is released to lower the runner 23, the short ribs 22 are pivoted to collapse the long ribs 21, thereby closing/collapsing the canopy frame 24 and thus the shade 25. In this embodiment, the canopy support hub includes the crown 18, which defines the canopy support hub axis 26 (which shares the same axis as the anchor pin 52, anchor support 44, and the runner 23).

In this embodiment, given engagement of the anchor pin 52 to the anchor support 44, when the pivot joint 40 rotates (i.e., by rotating the anchor support 44 with rotation of the

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shell 41 and gear 57), the canopy 20 rotates along with the pivot joint 40. However, if anchor 50 is rotatably received in the anchor guide 46, and if the drawstring is rotatably connected to the anchor 50, then the canopy 20 may freely rotate with respect to the pivot joint 40, thereby the canopy 20 does not need to rotate along with the anchor guide 50.

As can be appreciated from the drawings, given the fixed tilt angle between the pivot joint rotation axis 28 and the canopy support hub axis 26, as the pivot joint 30 rotates about its axis 28, the canopy 20 is rotated along with the rotation of the pivot joint 30, thus causing the canopy support hub axis 26 to tilt (in particular, the axis 26 rotates about axis 30, prescribing a path corresponding to the surface of a cone with axis 28). As a result, the canopy 20 changes its orientation with respect to the supporting arm 16. FIGS. 14A-14C illustrate orientations of the canopy frame 24 with rotation of the pivot joint 40 (the shade 25 is omitted from view, so as to more clearly show the relative position of the canopy frame 24 to the arm 16). FIG. 14D illustrates further tilting of the canopy 20 with a change of position of the cantilevered arm 16, by moving the cantilever support 15.

Accordingly, unlike the prior art configurations, the orientation of the canopy 20 in the patio umbrella 10b can be changed without requiring rotation of the supporting arm 16 from which the canopy 20 is supported at its extended end. Further, unlike the prior art, the orientation of the canopy 20 can vary in more than one plane and/or with more than one degree of freedom with respect to the support arm 16, given that the axis 26 can be essentially swiveled in space, not confined to movement within a particular plane. This embodiment further allows the canopy 20 to be pivoted to close to the arm 16 for storage.

In one embodiment, the pivot joint 40 is structured to freely rotate about its axis 28 when the canopy 20 is manipulated by a user (e.g., turning the canopy about the joint axis 28) to pivot or tilt the canopy to a desired orientation. In the illustrated embodiment, to facilitate user rotation of the canopy 20, the rotation of the pivot joint 40 is facilitated by a drive mechanism, which may take a structure similar to that shown in FIG. 5. However, it is desirable to provide a drive mechanism to resist undesired rotation of the pivot joint with respect to its housing (e.g., by strong winds or a person). For example, the drive mechanism would be structured to be self-locking, e.g., using worm gear drive, such that the joint cannot be easily rotated under strong winds or by the user turning the canopy. Alternatively, a separate locking mechanism may be provided to securely lock the pivot joint in place at a desired rotated position (whether or not there is a gear drive mechanism) with respect to the joint housing, so as to secure the canopy in the desired tilted position. For example, indexing keys, locking pin and groove/hole mechanism, etc. may be provided for the pivot joint and its housing.

Referring to the embodiment illustrated in FIGS. 11A-B and 12A-C, the pivot joint 40 is coupled to the extended end of a drive shaft 37 by a system of drive gears and belts, which provides a drive mechanism having a desired gear ratio and improved integrity, stability and durability. In this embodiment, the drive mechanism includes a worm drive (e.g., a worm 56 and a worm gear/wheel 57 connected to the rotatable pivot joint 40) that rotates the rotatable pivot joint 40, a bevel gear drive at the end of the drive shaft 37, and a belt 59 coupling the rotation of the bevel gear drive 58 to the worm 56 of the worm drive. The drive shaft 37 is hollow, through which the drawstring 54 is free to slide within. In the illustrated embodiment, as noted above, the end of the



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drawstring **54** at the joint pivot **40** is coupled to the anchor **50** at the top of the runner **23**. (It is noted that the drawstring structure of this embodiment may be adapted and applied to the previous embodiment, with the drawstring **54** attached to the top of the runner **23** without the anchor **50**.)

The other end of the drawstring **54** is coupled to a lever or handle **36** near the sliding cantilever support **15**, similar to the previous embodiment. The drive mechanism thus provides a tool to provide leverage for facilitating a user to manually actuate the drive mechanism to rotate the pivot joint **40**. In the alternative or in addition, though not shown, the drive mechanism may be actuated by a motor drive, or a combination of manual drive and motor drive, replacing the crank handle **36**.

In another embodiment, the canopy support hub makes a variable tilt angle with respect to the pivot joint rotation axis. The canopy may or may not rotate along with the rotation of the pivot joint. As a result of the variable tilt angle between the pivot joint rotation axis and the canopy support hub axis. The rotation of the pivot joint causes tilting of the canopy support hub axis, thus tilting the canopy to change its orientation.

FIGS. **15A-15C** schematically illustrates a patio umbrella **10d** having a pivot joint rotation axis **28** at variable tilt angle to the canopy support hub axis **26**, in accordance with an embodiment of the present invention. The structure of the patio umbrella **10d** is generally similar to the structure of the patio umbrella **10a** to **10c** in the previous embodiments, with the exception of differences pertaining to the pivot joint **60** and the canopy frame **124** illustrated in FIGS. **15A-15C** (the shade **25** is omitted from view, so as to more clearly illustrate the shape of the canopy frame **124**). As illustrated, the rotatable pivot joint **60** is coupled to a canopy **120** via a variable tilt angle interface structure that comprises a flex joint axle **61**, which includes a rotatable joint axle **62** that rotates along a fixed axis **28** at a fixed tilt angle with respect to the cantilevered arm **16**, and a tilt joint axle **64**. This embodiment does not require rotation of the canopy frame **124** (and hence no rotation of the canopy **120**), thus less effort is required to change the orientation of the canopy **120**. The canopy frame **124** is designed to be "floating" with respect to the supporting arm **16**, as the overall shape and/or configuration of the canopy frame **124** can be varied by rotation of the pivot joint **60**. As the canopy frame **124** changes its shape, it effectively causes the overall orientation of the canopy to change.

Within the housing **69**, the rotatable joint axle **62** is supported to rotate by one or more support bearings **32** (in the illustrated embodiment, there are two bearings **32**). The end of the rotatable joint axle **62** is fixedly connected to a worm gear/wheel **57**, and a worm **76** at the end of a drive shaft **37** in the hollow cantilevered arm **16** rotates the worm gear **57**. The configuration of gear and bearings may be similar to the earlier described embodiments. A bevel gear drive (not shown but similar to those disclosed in the earlier embodiments) is provided at the other end of the drive shaft (e.g., nearer the cantilever support **15** as in the earlier embodiments) to couple a crank handle **36** to rotate the drive shaft **67**.

The tilt joint axle **64** is coaxially and slidably inserted into the runner **123**, as seen in FIG. **15B**. The common axis of the tilt joint axle **64** and the runner **123** is thereby the canopy support hub axis **26**. The tilt joint axle **64** is hingedly/pivotally attached to the rotatable joint axle **62** at hinge point **63**, thereby the tilt angle between the canopy support hub axis **26** and the rotatable joint axle axis (which defines the pivot joint axis **28** in this embodiment) can vary. In essence,

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the variable angle interface structure resembles a universal joint, or a flex joint coupling the pivot joint **60** to the canopy **120**.

A cam follower in the form of a roller **65** is provided at the side support **83** at the end of the tilt joint axle **64**, in operative engagement with a cam surface **68** defined at the edge or perimeter of a cylinder **81** that is coaxial with the rotatable joint axle **62** and fixedly supported by the pivot joint **60**. The profile of the cam surface **68** can be better seen in a similar cam surface **68** in the embodiment of FIG. **16B**. The cam surface **68** is configured with a continuous series of slanted surfaces about the rotatable joint axle **62**. The slanted surfaces **68** may be a combination of discrete surface sections at various angles with respect to the cam follower roller **65**, or continuous smoothly varying cam surface sections.

The crown **18** of the canopy is fixedly coupled to the base or housing of pivot joint **60**. The long ribs **121** are pivotally connected to an upper collar **71** that is fixedly attached to the base of the crown **18**. The upper collar **71** defines a central space **73** that allows the runner **123** to sway within that space. The short ribs **122** are pivotally connected to a lower collar **72** fixedly attached to the lower end of the runner **123**. With this structure of the canopy frame **124**, the canopy frame acquires a "floating" configuration, as the entire frame **124** can flex and take a shape depending on the tilt angle of flex joint axle **61** and the sway of the runner **23**. As is clear from FIG. **15B**, the top end of the runner **123** floats within the space of the upper collar **71**. In this embodiment, the canopy support hub comprises the lower collar **72**, which defines the canopy support hub axis **26**. The upper collar **71**, however, does not tilt with rotation of the pivot joint **60**.

As the user rotates the crank handle **36** to rotate the drive shaft **37**, the worm gear causes rotation of the rotatable joint axle **62**, thus rotating the tilt joint axle **64**. Given the flex joint axle **61** is not attached to the crown **18**, and the crown **18** is fixedly supported and does not rotate with the rotation of the flex joint axle **61**, when the follower roller **65** rolls against and follows the profile of the cam surface **68**, the tilt angle of the tilt joint axle **64** is varied with respect to the rotatable joint axle **62**. The cam follower roller **65** rolls against the cam surface **68**, thus varying the tilt of the canopy support hub axis **26** with respect to the pivot joint axis **28**. This causes the runner **123** to sway, to thereby vary the configuration and/or shape of the canopy frame **124**. As shown in the drawings, the long ribs **121** and the short ribs **122** articulates as the tilt joint axle is being tilted, thus causing the runner **123** to sway sideways (without the canopy rotating on its axis). As a result, the overall canopy **120** sways to tilt the canopy **120** to face different directions as desired. Consequently, the orientation of the canopy **120** varies accordingly, thereby facing different directions as desired by the user. Generally, the canopy **120** is generally facing the direction at which the longitudinal axis of the runner **123** (or the canopy support hub axis **26**) is pointed. This embodiment is particularly advantageous for large canopy, as rotation of a large, heavy canopy would require more effort by a user. With this embodiment, the desired orientation of the canopy can be achieved with the need to rotate the canopy to tilt the canopy. Reference is made to FIGS. **17A-17J**, which illustrate a slightly modified embodiment of a flex joint axle **64**, but nonetheless illustrate the variation in the tilt angle of the tilt joint axle **64** as the flex joint axle **61** of the pivot joint **60** rotates, as will be further elaborated below.

In this embodiment, the rotatable joint axle **62** and the tilt joint axle **64** are hollow, and a drawstring can run through

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such hollow axles to connect to the bottom of the runner **123** (or lower collar **72**) to allow lowering or raising the runner **123** with respect to the crown **18**, in a manner similar to the drawstring **54** described in the earlier embodiments. The runner **123** telescopes over the tilt joint axle **64**, wherein lowering and raising of the runner **123** in reference to the tilt joint axle **64** would operate to open and close the canopy **120** (in a similar fashion as in the earlier embodiment).

FIGS. **16A** and **16B** illustrate a pivot joint **60'** modified from the pivot joint **60** in the previous embodiment in accordance with yet another embodiment of the present invention. This embodiment is quite similar to the previous embodiment of FIG. **15**, with a flex joint axle **61'** that is similar to the flex joint axle **61** in the previous embodiment, except that the tilt joint axle **64** is fixedly connected to the crown of the canopy **20** in this embodiment, so as to rotate the canopy **20** when the flex joint axle rotates (canopy **20** not shown, but can be similar in structure to those illustrated in the earlier embodiments, e.g., FIGS. **1** and **10**). In this embodiment, the only modification is to the tilt joint axle **64**. Specifically, the extended end of the tilt joint axle **64** is provided with a coupling **80** for affixing to the crown **18** of the canopy **20**.

FIGS. **17A-17J** illustrate variation in the tilt angle between the tilt joint axle **64** (i.e., the canopy support hub axis **26**) and the rotatable joint axle **62** (i.e., the pivot joint rotation axis **28**) with rotation of the flex joint axle in the pivot joint **60'**.

For all the above described embodiments, the extent of the tilt angle between the canopy support hub and the pivot joint rotation axis in the pivot joint depends on one or more of the following considerations: size of the canopy, extent of the opening of the canopy, weight of the canopy, range of orientations of the canopy (i.e., the range of directions of the support hub axis), orientation of the pivot joint rotation axis with respect to the supporting structure (e.g., the side arm to which the pivot joint is supported), position of the side arm, and/or desired application of the umbrella. Generally, such tilt angle can be less than greater than 0 degrees to about 45 degrees.

In the drawings, some of the components (such as the canopy, crown, drawstrings, etc.) are not specifically shown and/or, but they are similar in structure to the corresponding components specifically described and/or illustrated in connection with other embodiments.

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While the present invention has been described above in connection with the illustrated embodiments, the scope of patent invention covers all possible present and future variations and improvements that is apparent from the disclosure above. While the invention has been particularly shown and described with reference to the preferred embodiments, it will be understood by those skilled in the art that various changes in form and detail may be made without departing from the spirit, scope, and teaching of the invention. Accordingly, the disclosed invention is to be considered merely as illustrative and limited in scope only as specified in the appended claims.

The invention claimed is:

**1.** An umbrella, comprising:

- a support structure, wherein the support structure comprises an arm having an extended end, and wherein the arm has a longitudinal arm axis;
- a canopy defining a first axis, wherein the canopy is coupled to the extended end of the arm;

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a pivot joint coupling the canopy to the support structure, wherein the pivot joint is rotatable with respect to the support structure, about a second axis at a tilt angle with respect to the first axis, and wherein the second axis is at a non-zero angle to the arm axis at the extended end,

wherein orientation of the canopy can be changed with respect to the support structure by rotating the pivot joint.

**2.** The umbrella as in claim **1**, wherein the canopy comprises a frame including a hub defining the first axis, wherein the hub is coupled to the pivot joint.

**3.** The umbrella as in claim **1**, wherein the tilt angle is fixed.

**4.** The umbrella as in claim **3**, wherein the canopy rotates with rotation of the pivot joint.

**5.** The umbrella as in claim **1**, wherein the tilt angle is variable as the pivot joint is rotated with respect to the support structure about the second axis.

**6.** The umbrella as in claim **5**, wherein the canopy does not rotate about the first axis with rotation of the pivot joint about the second axis.

**7.** The umbrella as in claim **1**, wherein the orientation of the canopy can be changed in more than one plane.

**8.** The umbrella as in claim **1**, wherein the orientation of the canopy can be changed with more than one degree of freedom.

**9.** The umbrella as in claim **1**, wherein the orientation of the canopy can be changed without rotation of the support structure.

**10.** The umbrella as in claim **1**, wherein the pivot joint comprises a fixed cylinder rotatable about the second axis, and wherein the fixed cylinder is coupled to the canopy via a wedge-shape interface structure to define the tilt angle that is fixed for the first axis.

**11.** The umbrella as in claim **1**, wherein the pivot joint comprises a disengageable anchor coupling.

**12.** The umbrella as in claim **11**, wherein the disengagement anchor coupling comprises an anchor support that is rotatable with respect to the support structure about the second axis, and an anchor engageable with the anchor support defining the first axis, wherein the anchor is connected to the canopy.

**13.** The umbrella as in claim **12**, wherein the anchor coupling further comprises an anchor guide, guiding engagement of the anchor to the anchor support.

**14.** The umbrella as in claim **13**, wherein the anchor comprises an extended anchor pin that engages with a complementary opening in the anchor support.

**15.** The umbrella as in claim **1**, wherein the pivot joint comprise a flex joint axle, which varies the tilt angle as the pivot joint rotates.

**16.** The umbrella as in claim **15**, wherein the flex joint axle comprises a tilt joint axle pivotally connected to a rotatable joint axle, wherein the rotatable joint axle is supported for rotation with respect to the support structure about the second axis, and the tilt joint axle is coupled to the canopy and rotates about the first axis with the rotation of the rotatable joint axle.

**17.** The umbrella as in claim **16**, wherein the flex joint axle further comprises a cam surface fixedly coupled to the support structure and a cam follower coupled to the tilt joint axle, and wherein with the rotation of the tilt joint axis causes the cam follower to follow profile of the cam surface, which tilts the first axis at varying tilt angles, thereby tilting the canopy to face different orientations.

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**18.** The umbrella as in claim **17**, wherein the canopy does not rotate about the first axis with rotation of the pivot joint about the second axis.

**19.** The umbrella as in claim **17**, wherein the canopy is connected to the tilt joint axle for rotation therewith. 5

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